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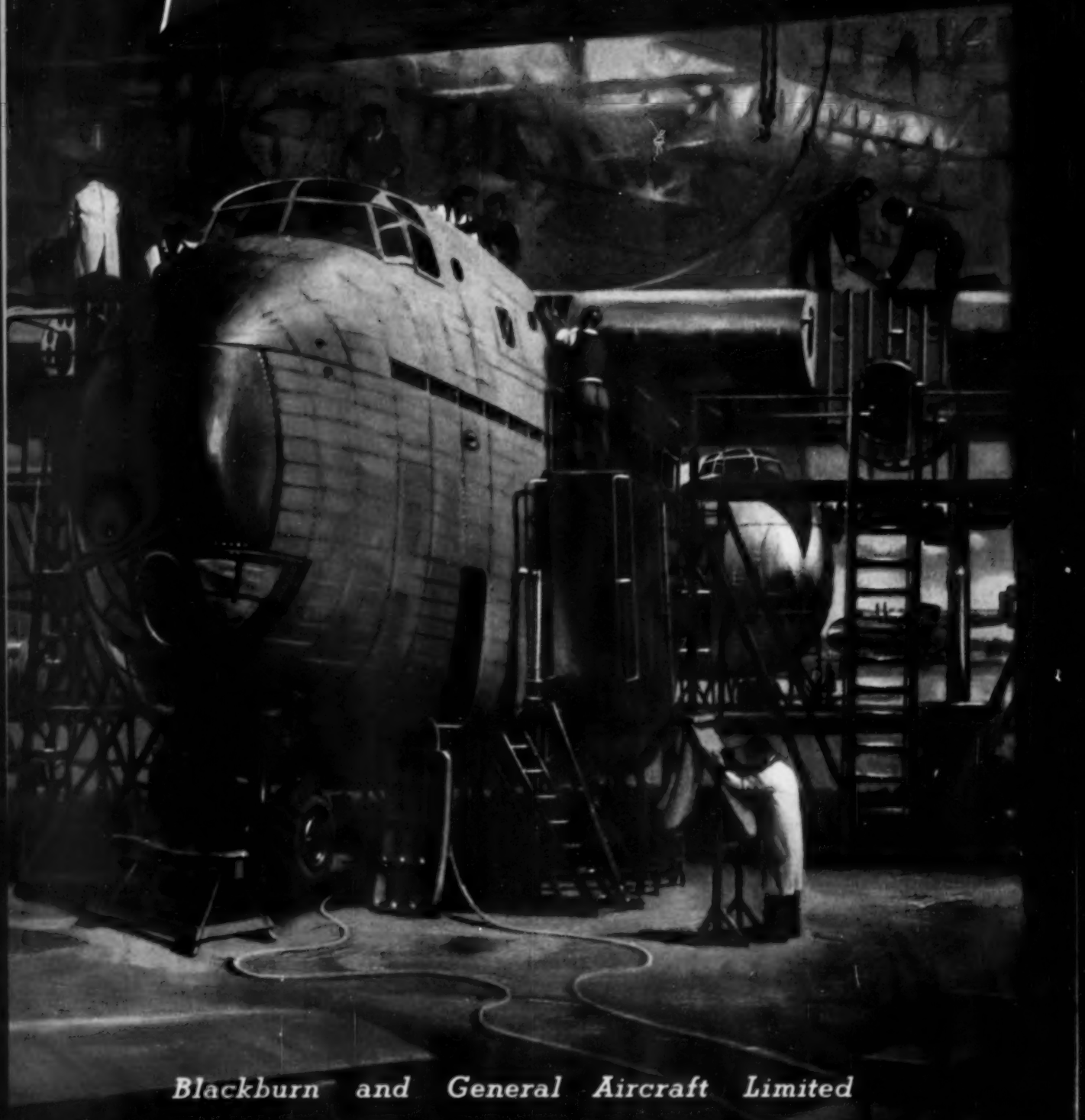

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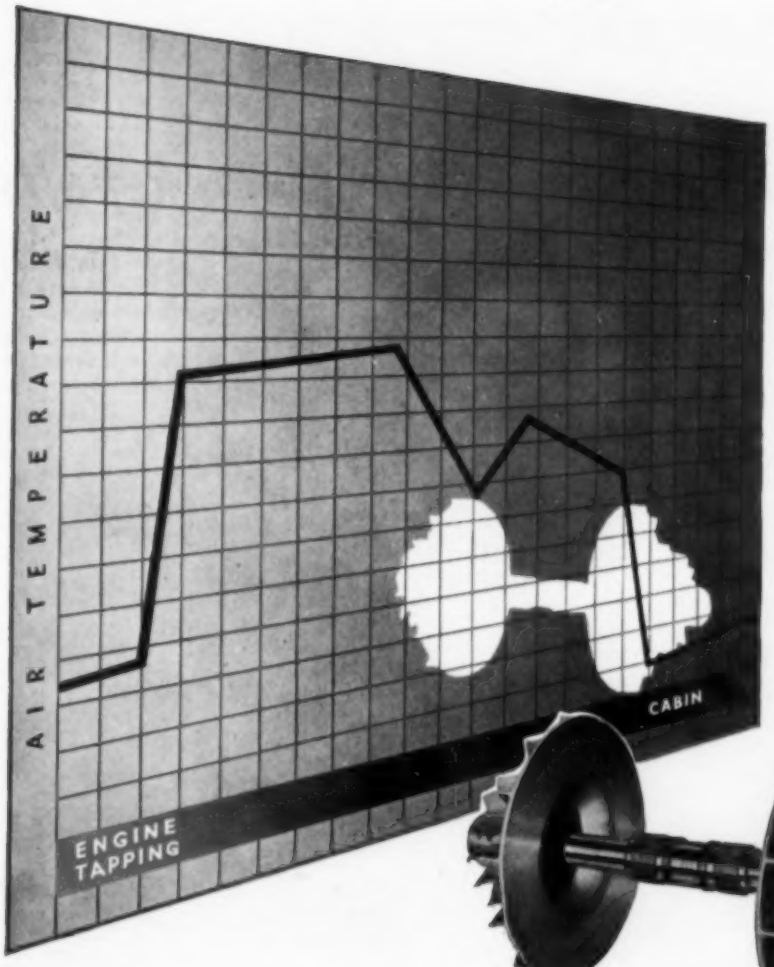

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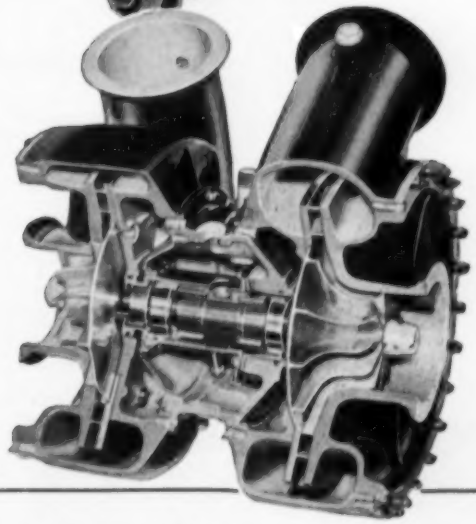

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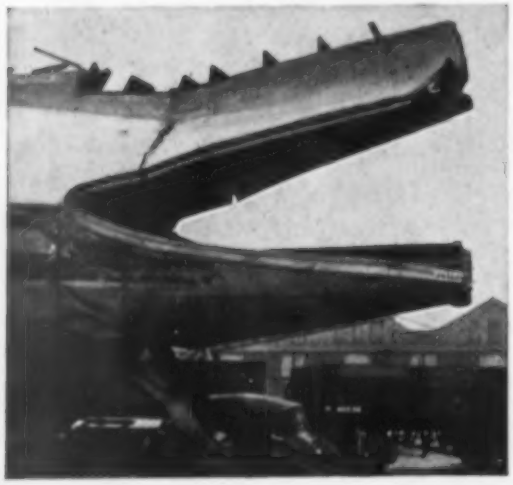
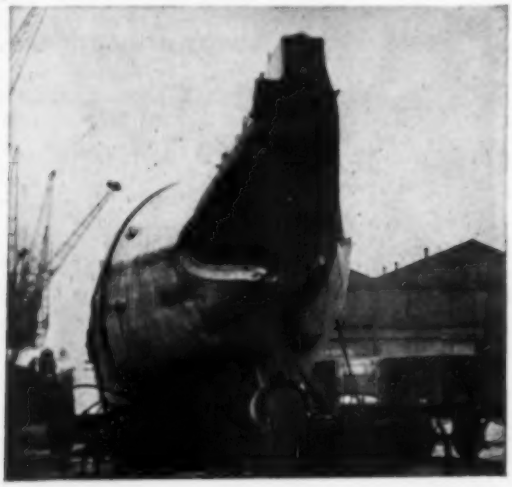
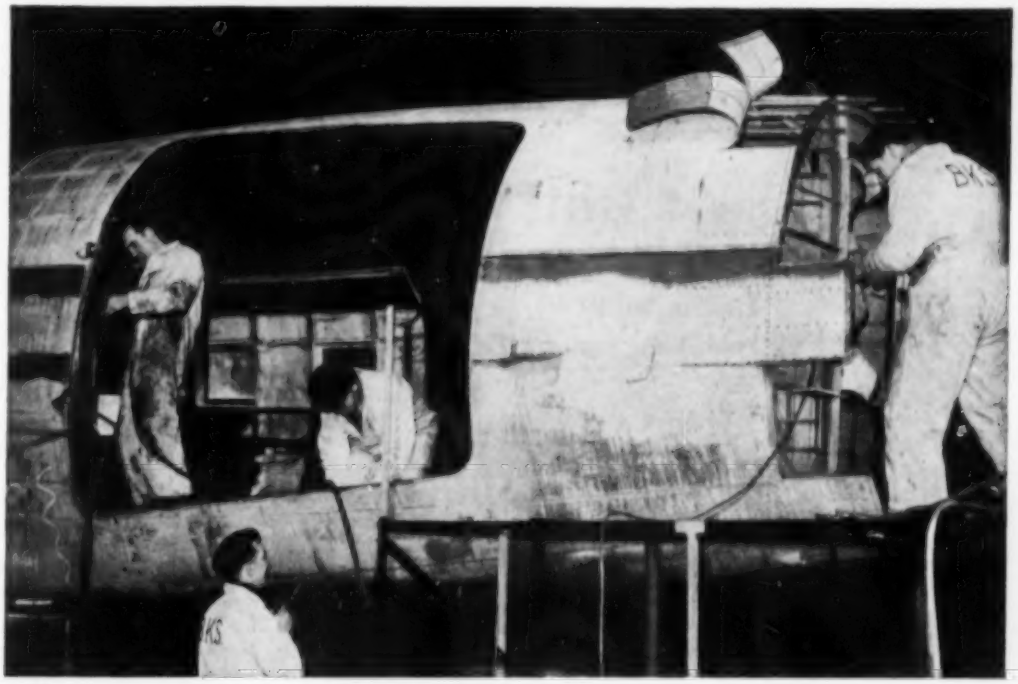
At the docks in the United Kingdom, the aircraft was seriously damaged when a lifting hoist failed, the complete rear end of the fuselage being badly twisted, together with severe damage to the nose of the aircraft.

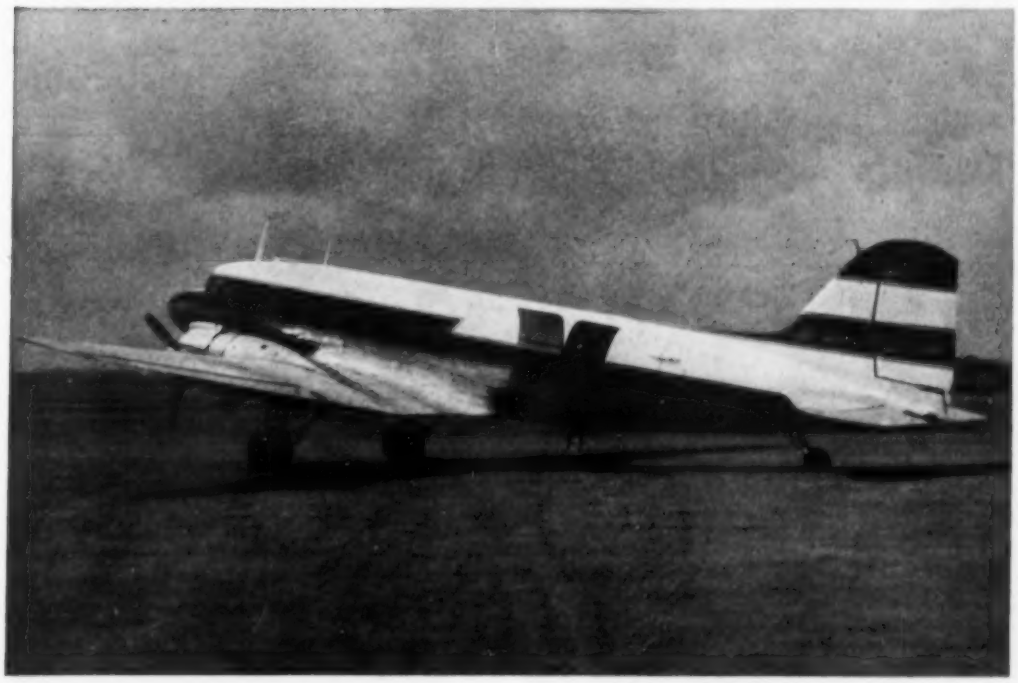




On arrival at Southend we fitted a new centre section, one new wing and removed the complete tail assembly.

A replacement tail section was spliced on to the damaged fuselage and the whole area of the joint re-skinned.





The aircraft, which was at first considered a complete write-off, was then flown back to the Middle East within ten weeks of its arrival.

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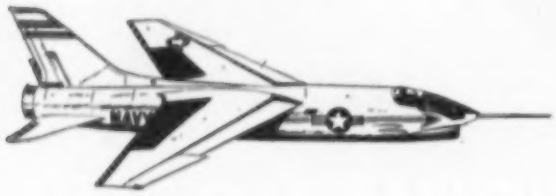
PRATT & WHITNEY AIRCRAFT'S J-57 TURBOJET TO POWER NEW AIRLINER, NEW FIGHTER

Two of America's newest aircraft, a commercial transport type and a U. S. Navy jet fighter, will be powered by 10,000-pound thrust class Pratt & Whitney Aircraft J-57 turbojet engines, according to recent announcements. The passenger transport is the coming Douglas DC-8; the fighter is Chance Vought's sleek XF8U-1.

Four advanced J-57 engines will give the swept-wing DC-8 a top speed of 550 miles per hour. It will be able to carry 80 to 125 passengers, and is designed for long-range international or transcontinental service. Typical DC-8 flying time between New York and Paris, for example, would be 6½ hours.

According to announcements, the DC-8 will be ready for initial test flight by December, 1957, and for delivery to airlines beginning in 1959.

Span of the DC-8's swept wings will be 134.6 feet, length 140.6 feet and over-all height 40.2 feet. Gross weight of the overwater version will be 257,000 pounds. In spite of its tremendous size, speed and performance capabilities, the new transport will be able to operate from existing major air terminals at operating costs even lower than current airliners, the Douglas announcement said.



Chance Vought's XF8U-1, disclosed in June, is a carrier-based, air-superiority fighter. It has supersonic speed, high rate of climb and exceptional ceiling. Test flights have already been made at Edwards Air Force Base in California.

A proved power plant, the Pratt & Whitney J-57 with afterburner, combined with a trim, lightweight airframe, enables the plane to achieve its very high speed. In addition to high power, the J-57's outstanding fuel economy gives the new jet the long endurance needed for carrier operations.

The XF8U-1 is America's fifth fighter airplane type to be powered by J-57 engines. Others are the North American F-100, the McDonnell F-101, and the Convair F-102 all Air Force fighters, and the Navy's Douglas F4D.

NEW DC-7C TO HAVE HAMILTON STANDARD PROPELLERS

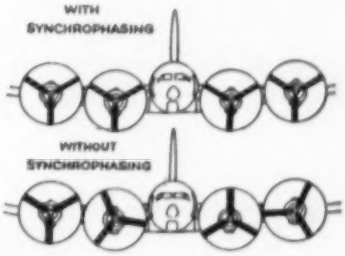
Special new propellers are being supplied by Hamilton Standard for the new Douglas DC-7C transports. These propellers are four-bladed 34E60 reversing Hydromatics, custom-designed for the big, long-range "Seven Seas", which is scheduled for delivery to airlines beginning in 1956. Manufactured of aluminum alloy, the propellers are 14 feet in diameter and have electric deicing.

Another feature of the DC-7C installation is automatic synchronization. In this system, electronic equipment designed and built by Hamilton Standard maintains precise control of all four propellers.

Hamilton Standard propellers currently are standard equipment on more than 90 per cent of all airline transports. Technical aid in service and maintenance of these propellers is provided by Hamilton Standard service representatives on duty throughout the free world.

HAMILTON STANDARD DEVELOPMENT KEEPS PROPELLERS "IN STEP"

Electronic equipment, to keep the propellers of multi-engined airliners "in step" with split-second accuracy, has been developed by Hamilton Standard. Known as Synchrophasing, the development provides an electronic method of controlling propellers to turn at a specified relationship to each other. The result is smoother and quieter flight.



Hamilton Standard engineers devised the basic system about 10 years ago. Today's emphasis on quieter, smoother flight spurred its development.

SWEDEN, CANADA GET SIKORSKY S-55s

Ostermans Aero, Ltd., of Stockholm, Sweden, one of Europe's first commercial helicopter operators, recently received its second Sikorsky Aircraft S-55 helicopter.

Using the versatile transport helicopters, Ostermans is pioneering, in Scandinavia, such helicopter services as rescue work. The firm has already started helicopter passenger flights between Malmo, Sweden, and Copenhagen.

In Canada, 10 Sikorsky S-55-type helicopters are being delivered to the Royal Canadian Navy. The Sikorskys will be assigned to HU21 Utility Squadron, and based at a Royal Canadian Naval Air Station in Nova Scotia. The rugged Sikorskys, a type proved in operations under the most severe weather and maintenance conditions, are to be used to meet all fleet helicopter requirements.

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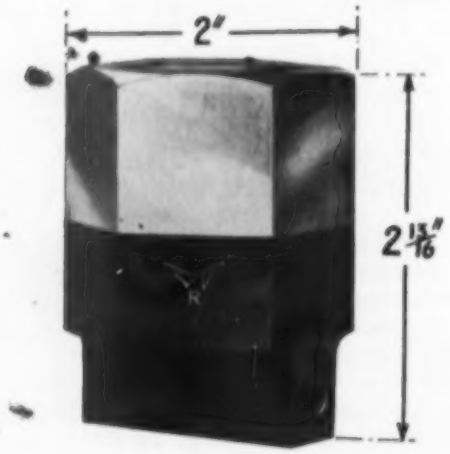

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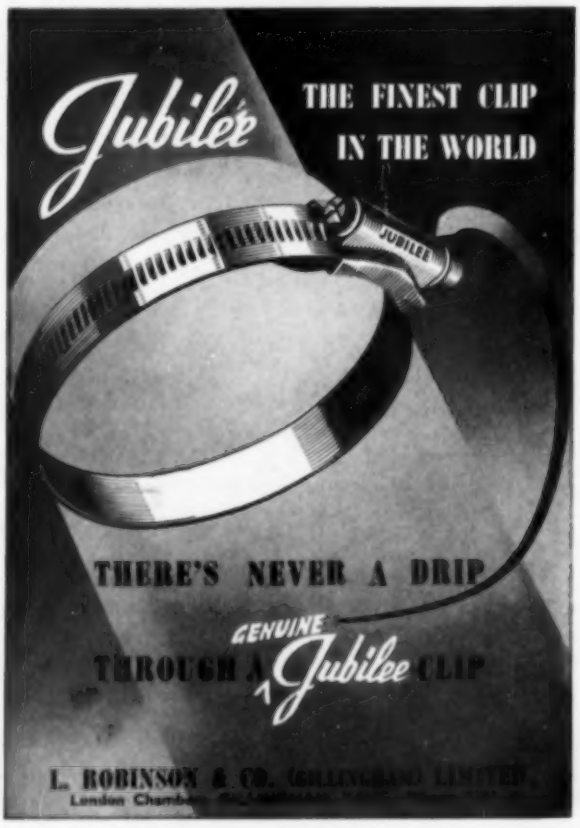

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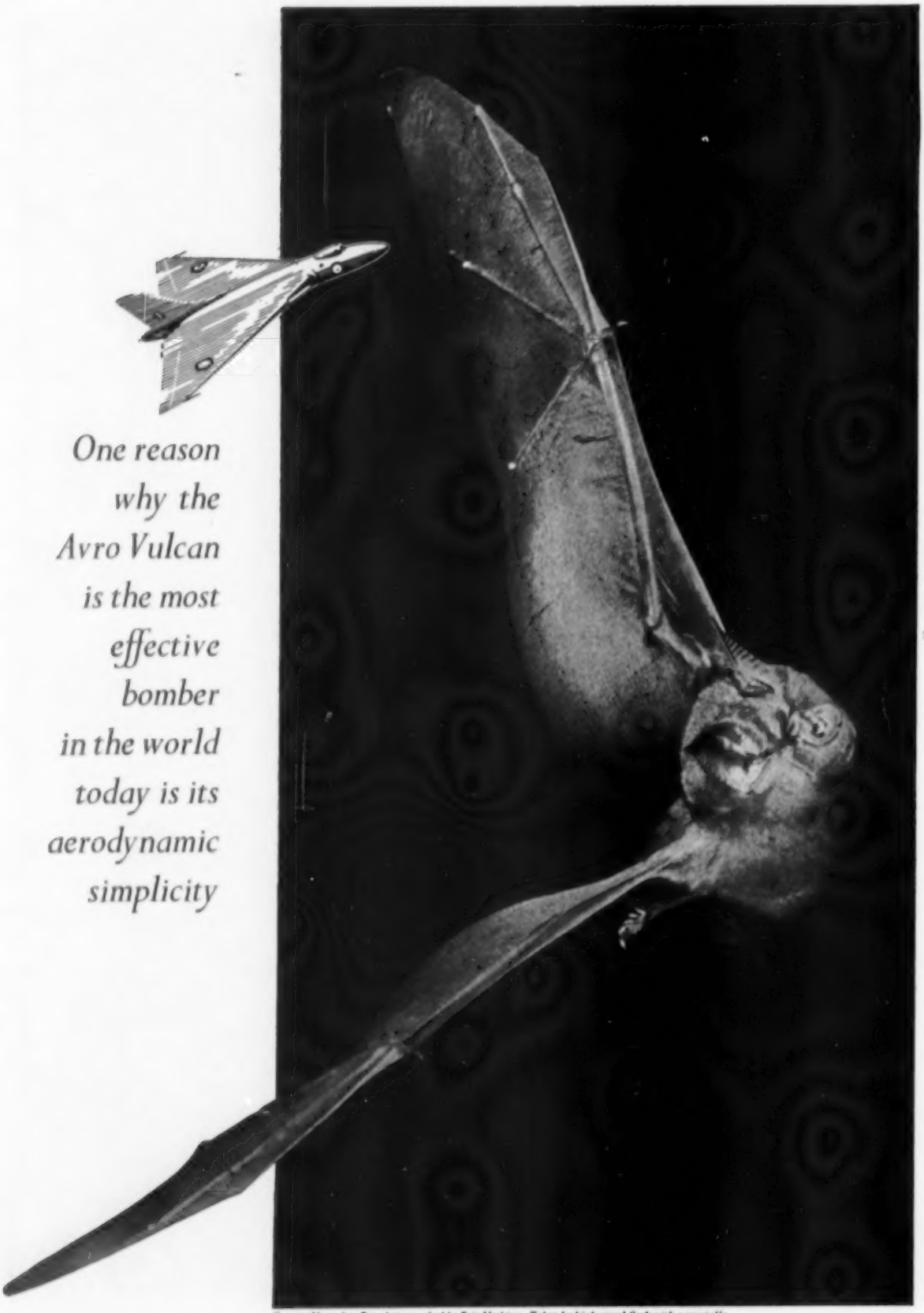
Photograph by South African Railways

B

One reason why the Avro Vulcan is the most effective bomber in the world today is its aerodynamic simplicity



Greater Horseshoe Bat photographed by Eric Hosking. Taken by high-speed flash with a specially constructed set giving 680 joules with two lamps at an exposure of 1/5,000th second at f/45.

First Aeronautical Weekly in the World

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Too Many PROtotypes?

NEW ideas in aviation can open up such attractive vistas that today's problems are sometimes eclipsed by tomorrow's prospects. Aviation is by its nature a forward-thinking business, and anyone involved in it is occasionally liable to let his fancy fly too far ahead of fact. At these times a strong jolt is needed to bring us back to earth.

In an entertaining but thought-provoking contribution to *The Financial Times*, Sir Miles Thomas provides just such a jolt. Writing, as chairman of B.O.A.C., on the problems of buying equipment for a large international airline, Sir Miles complains that the question of placing a multi-million-pound order for a new aircraft, and of deciding the point where its design must be frozen for production, is complicated by "the merry game of brochuremanship."

The form of play, as outlined by Sir Miles, is as follows: "As soon, almost, as a designer outlines a new configuration on the drawing-board he goes into a huddle with an engine man who happily 'guesstimates' what extra power some new turbine blades or compressor rotors or special fuels will give; and a sparkling new performance is extrapolated. . . . Meantime, as soon as firm A announces its world-beater, the sales department of firm B inspires its engineering department to drag even more exciting developments from the deeper recesses of its backrooms, and a still bolder and better design is drawn up."

In fairness to engineers, a conservative race, we may interpolate that commercial rather than technical influences are responsible for these high-powered sales battles. Most designers would undoubtedly prefer to develop their aircraft in near-secrecy, away from the rowdy market-place, and to sell them on demonstrable technical merit. Nor is it entirely to the salesman's taste to be extolling the virtues of the Superliner Mk 10 when the Mk 1 is still an immature prototype. But the present system seems likely to prevail as long as aircraft must be ordered from the drawing-board—or until the airways become glutted with new equipment.

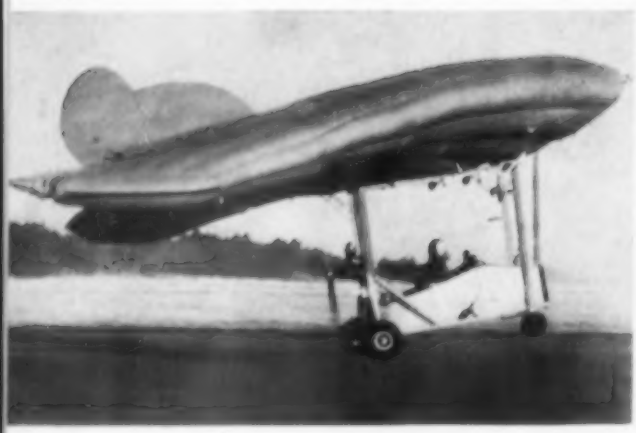
"Production, not Prediction"

Sir Miles also has some comments to make on the topical subject of the S.B.A.C. Show. From the commercial viewpoint, he believes, "the fetish of having something new every year puts too much accent on prototypes and insufficient on the production of saleable articles." He would like to see the industry give "less advance notice of what it is going to do, fewer circuses, lectures, banquets, displays and speeches. . . . What we in B.O.A.C. want today is production, not prediction." This is well worth saying, if only to air a catchy phrase. In fact, there is room for both. And one unquestionable merit of the Farnborough "circus" is the remarkable stimulus it provides throughout the industry to meet an annual deadline, to get the aircraft flying or the equipment finished.

Observing that this year the Britannia makes its fourth consecutive appearance at Farnborough, Sir Miles recalls that it was ordered by B.O.A.C. in July 1949 and will not be entering service until April next year. But, he adds, "not a moment has been wasted by the makers or by us in that long, expensive time. . . . It is vindicating the faith that saw the order signed in 1949."

"The Comet," he remarks, "streaked into public acclaim and should do so again when it flies, in a much reinforced form, in 1959." And while agreeing that the Viscount "is brilliantly upholding Britain's claim as a builder of world-worthy aircraft in the short-range market," Sir Miles bluntly points out that deliveries have fallen six months behind the original schedule.

In the article from which we have quoted, B.O.A.C.'s chairman has administered the shock-treatment—an attempt to nip the bud of complacent optimism which bursts into full blossom around the early part of September. His words will not be well received in all quarters. But they are, we believe, both timely and sincere. They should be interpreted not as the complaints of a disgruntled customer but as the counsel of a friend and supporter of the British aircraft industry.



BAGS OF WING AREA: The M.L. utility communications aircraft has an inflated wing and a separate tricycle chassis for pilot and passenger. It uses a 50 h.p. engine, has a speed range of about 18 to 50 m.p.h., a range of 100 miles and an empty weight with fuel of 550 lb.

FROM ALL QUARTERS

M.L. Utility Aircraft

MORE than one unlikely yet successful flying machine has originated in this country within the past year or two. Such enterprise is refreshing; and it is very encouraging, also, to know that the M.L. Aviation company's utility light aircraft (the existence of which was publicly revealed last week-end) enjoys official backing. It is, in fact, a joint venture on the part of the company and the Ministry of Supply. Mr. Marcel J. O. Lobelle, at one time Fairey Aviation designer, is responsible for the machine.

The intention in the first place was to produce a very simple and light aircraft for the use of the Army and perhaps the Navy and Air Force as well. The first prototype, which flew many weeks ago, has proved the feasibility of having an inflatable wing with a separate cockpit structure attached below. This kind of wing is cheap and light and when not in use can be rolled up and placed in a container for transportation in a jeep or other road vehicle, the chassis portion of the aircraft being towed behind. It should be made clear that the first aircraft is a one-off prototype and those which follow may differ in appearance, although the principle will be the same.

High quality dinghy-type fabric is used for the large-area wing and the plan form is of delta shape. The leading edge sweep is 45 deg, that of the trailing edge less. The vertical tail surface fitted to the prototype is not likely to be retained in the future. Spanwise fabric diaphragms are used to maintain the contour of the wing, which roughly conforms with that of a more conventional lifting surface, and the construction may be said to follow a cylindrical concept so far as the inflated bays are concerned. The correct planning of the diaphragms (which represent spars and ribs) is very important. Two separate inflated surfaces at the trailing edges serve as elevons, i.e., they are used differentially as ailerons or together as elevators.

The wing weighs about 100 lb and may be inflated with the aid of either a mechanical pump or bellows. In the air a small windmill pump keeps it topped up to its low pressure of under 1 lb/sq in. A relief valve guards against excess pressure building up if the aircraft ascends several thousand feet. In fact, however, the machine is not intended to climb high or alter its altitude by more than 1,000 or so feet from that at take-off.

The inflated wing attaches by lacing to a four-poster-like chassis containing tandem seats for pilot and passenger and carrying the engine mounting and fuel tank. The single control column hangs from the wing and operates through cables in the normal way. For convenience, the first chassis is of mixed wood and tubular metal construction. A number of bracing wires stretch between the wing under-surfaces and the chassis, picking up on lugs on the wheel hubs. Three lightweight Palmer wheels are fitted, the front one being steerable by the pilot's feet; brakes are also provided.

A rather unsuitable McCulloch constant-speed engine intended for pilotless aircraft is installed at present. It produces some 65 h.p. This will be replaced by a Walter Mikron in later machines, installed either as pusher or tractor. Later still, a home-built engine may be adopted. An output of about 50 h.p. is required.

With petrol for 100 miles, the machine weighs only 550 lb and it can carry a useful load of some 400 lb more. Take-off and landing speeds into wind are of the order of 18 m.p.h. and the cruising speed is about 45 m.p.h. These figures could be varied according to wing area but would preserve about the same ratio.

The span of the first machine, which flew at Farnborough, is 40ft and the length some 17ft 6in. The height from ground to the underside of the wing about the pilot's head is 5ft 7in and the maximum thickness of the wing 4ft 6in. So far as A.P. 970 makes provisions for such a structure, the M.L. conforms with them.

The makers have in mind the possibility of civil versions, including a design of interest to farmers; but these must be at least a year away, even as projects.

Making the official announcement, the Ministry of Supply stated that it had placed a contract for the construction of a light, cheap-to-produce and easy-to-pilot communications aircraft with M.L. Aviation Co., Ltd., of White Waltham, Berkshire. It added that military and civil applications were foreseen, particularly in areas where road communications were poor.

Sir Francis McClean

IT is a melancholy coincidence that, within three weeks of the unveiling of the Eastchurch Memorial to Pioneer Airmen, Sir Francis McClean, A.F.C.—whose name is among the 13 inscribed upon it—should have passed away. He died Thursday of last week, on August 11th, in a London nursing home, at the age of 79.

Frank McClean as many older R.Ae.C. members will recall him.

His name will be inseparably linked both with the earliest days of British heavier-than-air flying and with the progress of the Royal Aero Club. Born on February 1st, 1876, the son of Dr. Frank McClean, F.R.S., and educated at Charterhouse and Clifton, Frank McClean adopted civil engineering as a profession. After a short time with the Indian Public Works Department he returned to this country and, in 1907, made his first balloon ascent, accompanying Griffith Brewer in the Gordon-Bennett Rac. of that year. When, at this period, Frank Butler resigned from the Aero Club (it was not to be "Royal" until 1910), McClean was elected to the committee in his place; and he was destined to be an official of the club for nearly 50 years; at the time of his death he was a vice-president. For two periods, from 1923 to 1924 and from 1941 to 1944, he was chairman.

To revert to the early days, McClean flew with Wilbur Wright at Le Mans in December 1908, and thenceforth became imbued with a burning enthusiasm for heavier-than-air flying—an enthu-

siasm that speedily took practical shape in his co-operation with the three Short brothers, Oswald, Eustace and Horace, in the building of aeroplanes; the machines were flown in the Isle of Sheppey, first at Leysdown and later at Eastchurch, in each case on ground bought by McClean. It was at these two airfields that members of the Aero Club made their earliest flights.

In 1911, after consultation with other Aero Club committee members, Frank McClean put forward a proposal that the Royal Navy be invited to share the facilities of Eastchurch for the flying training of officers and petty officers. The Admiralty accepted—agreeing to pay the modest rent of £150 per annum—and thus there came into being England's first Naval flying school. The War Office refused a similar offer.

Meanwhile, McClean had himself learned to fly, taking Certificate No. 21 in 1910. He flew the new Short productions, including the then startlingly novel twin-engined biplane, which had a power unit driving a pusher propeller and another, mounted forward, driving twin tractor airscrews outboard of the nacelle. On many of his flights he was accompanied by his sister as passenger.

Aviation was not McClean's only interest; he was, for instance, a pioneer of under-water photography, and in 1912 took some remarkable photographs of the wreck of the *Oceana* off Eastbourne. But the air was his favourite medium, and in the same year he caused a stir by flying a Short seaplane up the Thames and through Tower Bridge and several other bridges—a feat that earned the disapproval of the Royal Aero Club.

In 1914 he took a new four-seater Short seaplane to Egypt, and flew it by stages, mainly with full loads, up the Nile from Alexandria to Khartoum.

During the 1914-18 war he served with the Royal Naval Air Service, first in Channel patrol flying and later as an instructor at Eastchurch. He was later commissioned in the R.A.F., but resigned in 1919. In the post-war years he was to be seen at every aeronautical sporting event, usually visiting them either by air or in his big white Rolls-Royce. In 1923 he was the entrant of the winning aircraft (a Sopwith Gnu flown by S/L. W. H. Longton) in the first Grosvenor Challenge Cup Race. Three years later, in recognition of his services to British aviation, he was knighted; and in the same year—1926—the R.Ae.C. awarded him its highest honour, the club's Gold Medal.

Sir Francis married in 1918, and his wife and two daughters survive him.

A private cremation took place on Monday last, and it is understood that ashes are to be scattered at Eastchurch. A Memorial Service is to be held next Thursday, August 25th, at Christ Church, Down Street, London, W.1, at 12 noon.

Beverley Abroad

BLACKBURN Beverley XB 262, which left Boscombe Down on Thursday, August 4th, bound for Idris, *via* Mar and Luqa, is well advanced with its tropical trials. Flying times for the three outward bound legs were 3 hr 20 min, 3 hr 30 min and 1 hr 20 min respectively. The outward flight was made at an a.u.w. of 135,000 lb, made up of 23 crew and passengers, an S-55 helicopter and a large supply of spares for both aircraft.

The aircraft is on M.o.S. charge with F/L. Stuart-Smith in command, assisted by Blackburn's chief test pilot, Tim Wood. The technical work is being carried out by staff from Blackburn and representatives from Bristol, de Havilland and the A.R.B. It is hoped that some of the trials for the M.o.S. will also be of use in obtaining a C. of A.

It is of interest to note that M.o.S. now operate a system of flight-test approval whereby a company's flight test team carries out work on behalf of A. and A.E.E. This system, although much more limited, is similar in concept to that of design approval which has been successfully used by A.R.B. for some years now.

The M.o.S. tests are being carried out with the rear door removed, and an accompanying photograph shows the flow-straighteners. Consistent use has been made of the aircraft's reversible-pitch airscrews, and the party trick of reversing into a parking space has now become a useful reality.

THE NEW BELL X-2, referred to below. The test flights are being made by Lt-Col. Frank K. Everest.

The Bell X-2

SEEN in a photograph on this page is the Bell X-2, latest of the high-speed, high-altitude research aircraft built for the U.S.A.F. Considerably more conventional in appearance than its brethren in the "X" series, the new rocket-powered Bell is painted white over all to assist in dissipating air-friction heat. Parts of the aircraft are constructed of stainless steel for the same reason, and it seems likely that the cockpit is jettisonable as a capsule.

The wing leading-edge is razor-sharp and the very-narrow-track undercarriage is accommodated in a long ventral fairing. The ailerons each carry a large aerodynamic tab projecting behind the trailing-edge.

B.E.25-Princess Performance

PAYLOAD-RANGE capabilities far beyond those of any commercial landplane, existing or projected, are attributed to the Princess flying-boat in a new brochure published by Saunders-Roe, Ltd. The brochure summarizes the estimated performance of the re-engined Princess with six Bristol B.E.25 turboprops in place of the ten "under-rated and experimental" turboprops (Bristol Proteus 3s, installed as four coupled and two single units) fitted for the first flight trials.

These trials, it will be recalled, began in August 1952 and ended in April 1954, when it was decided to Cocoon all three Princesses until suitable power plants could be supplied. Saunders-Roe say that design investigations into the possibilities

HOT WORK: The accompanying photographs reach us from North Africa, where the Blackburn Beverley is now undergoing its tropical trials. The smaller picture shows the flow straighteners fitted after the rear loading doors have been removed.

FROM ALL QUARTERS . . .

B.2+B.8=VN828: This hybrid Canberra, referred to in a news item below, has a B.2 airframe and a B.8-type nose with offset canopy and a large radome. The experiment may presage an all-weather fighter version of the Canberra.

of fitting other engines at present under development have shown that "several types are suitable."

Each delivering 4,000 s.h.p. plus 2,720 lb s.t. at take-off (5,045 e.h.p.), the B.E.25s would be installed in six similar nacelles partly submerged in the leading edge of the wing. They would drive four-bladed de Havilland airscrews of 16ft 6in diameter with full reversible control. No increase is envisaged in the total fuel capacity of 14,500 gal, stored within the wing in four integral tanks. Take-off weight of the B.E.25 Princess is quoted as 345,000 lb compared with the original figure of 315,000 lb. There seems no reason to assume, therefore, that installation of the more powerful and more efficient engines would involve many structural modifications other than in the vicinity of the power units themselves.

The B.E.25 Princess, say the makers, has been "designed to meet the requirements of a non-stop service between England and New York against possible headwinds of up to 80 kt over the whole distance of 3,000 n.m.," but that it would also be suitable for world-wide operations. Its applicability to a variety of other routes seems assured by the Princess's ability to cover airline stages of almost unprecedented length, including the routes radiating from London to all the principal centres of the Commonwealth, United States, South America, and to cope with temperatures ranging from −5 deg C to +35 deg C at sea level and down to −70 deg C at altitude.

Apart from its great range and its independence of runways, the B.E.25 Princess has two associated qualities of great commercial appeal: a highly competitive cruising speed and unequalled payload capacity. Its estimated cruising speed at a mean operating height of 32,000ft is quoted as 311 kt (358 m.p.h.). In de luxe form the B.E.25 Princess will carry a payload of 40,385 lb—equivalent to 130 passengers, freight and mail—for a still-air distance of 5,250 n.m. The high density trooping version with 220 passengers and baggage (52,437 lb payload) is credited with a still-air range of 4,630 n.m.

The following figures are given for take-off performance (I.S.A. still-air) at 345,000 lb: distance to unstick, 2,240 yd; distance to 50ft from rest, 2,780 yd; sea level rate of climb would be 1,000 ft/min.

Canberra All-weather Fighter?

NEWS was released last week of the possible development of an all-weather fighter version of the Canberra. It is not altogether certain that such a machine will in fact go into production, but the potentialities of the Canberra airframe for applications of this kind have always been obvious. A B.2 airframe has been modified, forward of the wing leading-edge, to take a B.8 nose with bubble canopy offset to port, and a long pointed radome containing A.I. gear. The last-named installation has been designed by Boulton Paul Aircraft, Ltd., who also make the four-cannon gun-pack with which the all-weather version would be armed.

It has also been stated that all future versions of the Canberra, including the P.R.9, will have the offset canopy—which, incidentally, is closer to the wing leading-edge than was the earlier dome enclosure. Photographs of the all-weather experimental Canberra show a crew access door positioned forward of the pilot's cockpit on the starboard side, suggesting that with this layout the crew sits forward of the pilot instead of behind him as in the B.2 and other marks. A further obvious possibility in the all-weather field would be the adaptation of the P.R.9 for this rôle.

The all-weather Canberra, bearing the serial number VN828, stated to be "purely experimental," is at present being test-flown from the Ministry of Supply's airfield at Defford, Worcs.

COURSE WITHIN A COURSE: The 17-mile circuit from Baginton, Coventry, over four laps of which the King's Cup Race will be flown tomorrow, August 20th; over the shorter course the National Air Races will be held (details were given on p. 213 last week). In addition to the racing there will be the British Lockheed Trophy aerobatic competition and an air display. Practice takes place today, Friday.

English Electric Appointments

FOUR new appointments in the aircraft division of the English Electric Co., Ltd., at Warton, Lancs., are announced. Mr. F. D. Crowe, B.Sc.(Eng.), A.F.R.Ae.S., and Mr. A. E. Ellison, A.M.I.Mech.E., who have both been assistant chief designers, are now chief designers, each heading separate teams—Mr. Crowe is responsible for all Canberra work, and Mr. Ellison for the P.1

WARTON QUARTET: The four members of the English Electric Company whose new posts are referred to above: (left to right) Messrs. Crowe, Ellison, Creasey and King.

***BRITANNIA BUILD-UP:** Eight Britannia 100s in the main erecting hall at Filton. The aircraft shown are the 4th-11th inclusive of B.O.A.C.'s order for 15 Mk 100s; all subsequent Britannias will be of the larger Mk 300 type. Present schedules call for delivery of four Britannia 100s to B.O.A.C. by the end of the year, followed by the opening of scheduled services in April, 1956.*

and its development. Mr. R. F. Creasey, B.Sc.(Eng.), formerly chief project engineer, is now assistant chief engineer, responsible for all new designs in the initial stages, and Mr. J. C. King, M.Sc.(Eng.), A.F.R.Ae.S., who has been experimental engineer, becomes assistant chief engineer responsible for special development work and facilities.

Mr. Crowe has played a considerable part in the development of the Canberra, having worked on the design since its inception in 1945. He is now busily occupied in bringing the latest variants into service. He joined the company in 1944 and was appointed chief draughtsman in 1949, and assistant chief designer in 1952.

Mr. Ellison went to English Electric as assistant chief designer in 1949 after being with the Airspeed Company from 1931 onwards; during his final years there he was closely concerned with the development of the Elizabethan. Now, at Warton, he is occupied with the design of 20 pre-production P.1s ordered by the M.o.S. Before joining Airspeeds, Mr. Ellison worked on the airship R.100 in association with Mr. Nevil Shute.

Mr. Creasey, who was responsible for the aerodynamic design of the P.1, was an aerodynamicist with Vickers-Armstrongs until, in 1946, he joined English Electric. During the war he worked with Dr. Barnes Wallis on some of the special-purpose bombs with which the latter's name is identified. He was appointed chief aerodynamicist at English Electric in 1950 and became chief project engineer in 1954.

Mr. King, A.F.R.Ae.S., joined the company in 1945, after five years at the R.A.E., where he was engaged on structural testing. He was appointed experimental engineer at Warton in 1950, and undertook additional duties as administrative engineer in 1951.

Canadian Fairey Directorship

THE Fairey Aviation Company of Canada, Ltd., has announced the appointment to their Board of Rear Admiral James Calcutt Hibbard, D.S.C., R.C.N. (retired). The appointment is effective from August 1st, 1955. Rear Admiral Hibbard has had a long and distinguished career with the Royal Canadian Navy. Born in Ste. Malachie, Province of Quebec, he first became associated with the Navy through summer training with the R.C.N.V.R. in 1924. In 1926 he entered the R.C.N. and was posted to the Royal Naval Training College in Greenwich until 1931. During World War 2 Rear Admiral Hibbard commanded the Destroyer *Skeena* in the battle of the Atlantic and was awarded the D.S.C. and Bar. He was appointed to the staff of Captain (D) as Training Commander for crews engaged in the Battle of the Atlantic, and was later appointed to command of H.M.C.S. *Iroquois*. From 1945 to 1947 he was Deputy Chief of Naval Personnel, Ottawa, leaving that posting to assume command of H.M.C.S. *Ontario* until 1949. In 1950 Rear Admiral Hibbard returned to Ottawa as Chief of Naval Personnel, and in 1953 was promoted to Flag Officer, Pacific Coast.

More About the M.100

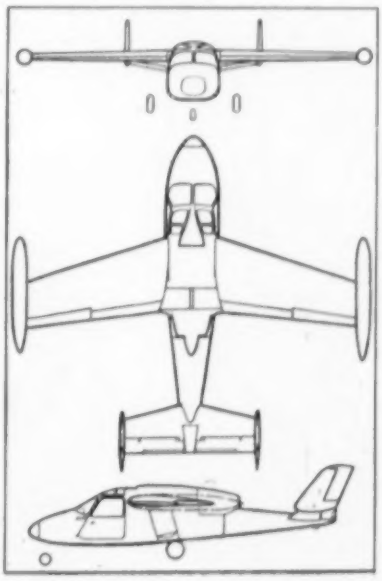
A STAGE has now been reached when F. G. Miles, Ltd., feel ready to release more details of the Type M.100 Student, their new jet trainer. A drawing is reproduced in column 2. As background, it is claimed that the designers were responsible for the introduction in this country of trailing flaps as a standard feature, side-by-side cabin layout for training, and the first monoplanes *ab initio* trainer to be standardized by the R.A.F. They comment that the majority of Service pilots will never fly operationally behind an airscrew again, and that a pilot spends costly hours learning a useless technique of taxying, take-off and landing with a tailwheel trainer, and acquires a primary set of reactions which he must unlearn before he is safe on operational types.

Design features of the M.100 include exceptional view for the pilot, unusually good entry and exit arrangements, and unobstructed access to the power unit or units. Doors open directly on to the seats on each side, and the floor of the aircraft is only 18in above ground level. As a result, it is possible to sit directly into the seat from the ground, or, in an air emergency, to dive out without the risk of fouling the structure, and without the necessity of assistance from ejector seats or inversion of the aircraft. Particular attention has been paid to control on the ground. Low c.g., in conjunction with nosewheel steering, is expected to give unusually good ground control.

The engine cowlings are to be quickly detachable, and the firewalls simply comprise the flat floor and flat sidepanels. When the sidepanels are detached, the whole engine and its accessories are open for inspection. The landing gear is fuselage-mounted, and therefore the central structure can remain on the wheels while wings and tail are removed.

In addition to its rôle as side-by-side trainer, several variants of the M.100 are foreseen. One might be a four-seat communications aircraft, to be fitted either with a single Marboré 2 or two Palas 600 jets. The possibility of a ground support version is foreseen, and for this duty the light wing-loading, manœuvrability and good forward vision should be valuable. For A.O.P. duties, with the single jet installation, a wing of increased span with full-span slots and modified flaps would be fitted. Rear-vision panels would be added to the sides of the engine fairings, and the entire cabin top and intake duct would be moulded from Perspex. In addition, bogie landing gear is under consideration.

Estimated performance and other data were given in *Flight* of August 5th, and the aircraft was illustrated last week. Maximum sea-level speed will be just over 250 kt for the training version and the landing speed will be only 60 kt. Other data are given below.



MILES M.100 STUDENT

One Blackburn-Turboméca Marboré 2 or two Palas 600

All-up weight:
3,100 lb (1,400 kg) as trainer.
3,600 lb (1,630 kg) as comms. a/c.

Dimensions:
Span ... ... 28ft (8.53 m)
Length ... ... 27ft (8.23 m)
Height ... 6ft 3in (1.90 m)
Wing area 140 sq ft (13.01 m²)
Wing loading (trainer)
22 lb/sq ft (3.5 kg/m²)

Design conditions:
Ultimate flight factor
10 at 3,100 lb
Diving speed
460 m.p.h. (740 km/hr)
Take-off weight
3,600 lb (1,630 kg)
Crash load factor ... 25 g

HERE AND THERE

JETS FOR CLANCY: Boeing's 707 jet tanker-transport prototype has now been fitted with a flying-boom refuelling system, more streamlined than on the KC-97. Similar booms are scheduled for the KC-135, already in production for the U.S.A.F. (Civil 707 pictures, p. 274).

New U.S. Air Secretary

NOMINATED to succeed Mr. Talbott as Secretary for the U.S. Air Force is Mr. Donald Quarles, 61, Assistant Secretary of Defence for Research and Development. Mr. Talbott resigned early this month after a Senate sub-committee had inquired into his outside business interests.

Earl's Court Beat-up

AT the Radio Show (August 24th-September 3rd), G.E.C. are to give a special sound-reproduction demonstration for which they have recorded, at Hatfield, the sound of a D.H. Venom passing overhead at 100ft. "Uncanny realism" is promised.

Belgian Medal Awarded

THE Belgian Government has awarded the Medaille D'Or de L'Ordre de la Couronne to Mr. Victor R. Godfrey, who for over 30 years has been on the staffs of the Fairey Aviation Co., Ltd., and Avions Fairey of Gosselies.

New Bréguet Administration

FOLLOWING the recent death of M. Louis Bréguet, a meeting was held at which a new administration council was elected, consisting of MM. Antoine Bréguet, Sylvain Floirat, René Fould, Lucien Gillet, Georges Hereil (representing S.N.C.A.S.E.) and Georges Glasser (representing S.N.C.A.S.O.). M. Floirat is to be director-general; he will be assisted by M. Jean Gandilhon as general manager and M. Gillet as general secretary. The capital of the company is shortly to be increased from 212,400,000 to one billion francs.

Valiant Amendment

THE official distance covered by the M.o.S. Valiant on the first leg of its Australian journey, the record-breaking stretch from London to Baghdad, differs slightly from the figure reported last week; the statute mileage, covered in 4 hr 51 m 28.8 sec, was 2,543.072.

Mountain Air Ambulance

TWO British climbers who lost their way on the Dent Blanche and suffered frostbite and other injuries were flown down from a hut, at an altitude of 13,000ft, by the famous "mountain pilot" Herman Geiger. He made two sorties in his Piper Cub to bring down the men, one of whom was a stretcher case.

"DEEP STRATA" SURVEY: Sponsored by the Nuffield Foundation, the first large-scale airborne magnetometer survey in Great Britain started on August 11th. Derby Aviation, Ltd., in co-operation with Canadian Aero Service, Ltd., of Ottawa, have equipped an Anson for the purpose. Dr. Stubblefield, assistant director of the Geological Survey, and Dr. W. Bullerwell, director Geophysics Department, will supervise. Others concerned include (l. to r.):
R. B. Paine (technical director, Derby Aviation), R. Wallis (pilot, Derby Aviation), P. O. Blass (Decca), T. Rowlands (project manager, Canadian Aero Service), H. A. Roxburgh (managing director, Derby Aviation), Homer Jenson (commercial manager, Canadian Aero Service), W. DesLauriar (i/c. data, Canadian Aero Service).

PROMISED FOR FARNBOROUGH

FLY-PASTS by Valiants and Hunters of the R.A.F. will be innovations at the S.B.A.C. display next month. On the three public days (September 9th-11th) the Hunter team of No. 54 Sqn. will perform.

In each day's "trade" display, the first group to take the air will be led by a Fairey Gannet T.2 and will include the Eland-Ambassador and also the Short Sperrin with a de Havilland Gyron turbojet in the lower port nacelle. The second group will be the Hunting Percival Provost, Auster Aiglet Trainer (to be replaced by the A.O.P.9 on the private days), Scottish Aviation Prestwick Pioneer, Percival Pembroke and de Havilland Heron. Then will follow the English Electric Canberra B.8, Hawker Hunter F.4 and Olympus Canberra; and these in turn will give way to helicopters—a Bristol Sycamore and Type 173, a Saunders-Roe Skeeter 6, Fairey Jet Gyrodyne, Westland S-55 and the latest development of the Westland S-51, the Widgeon. The new Fairey ultra-light may also be in on the act. A formation of Short Seamew light anti-submarine aircraft is to fly over, to be followed by the Handley Page Herald, Scottish Aviation Twin Pioneer, Vickers Valiant, Bristol Britannia 100 and de Havilland Comet 3. Before the Comet has landed the Percival Jet Provost will be airborne, to be followed by the English Electric Canberra P.R.9, Avro CF-100 and D.H.110. Next come production-type Vickers Valiant, Avro Vulcan and Handley Page Victor bombers, and the display will end with the Folland Gnat, two new marks of Hunter (presumably the F.6 and Hunter Trainer), a Supermarine Swift F.R.5, a Gloster Javelin and the Fairey F.D.2 delta-winged research aircraft. (The dimensions of this last-named machine have just been announced as span 27ft, length 52ft). The long-awaited English Electric P.1 will appear on the first three days only.

In connection with the Show, four special numbers of FLIGHT are appearing, as follows:—

August 26th (Friday next): Commonwealth Aircraft Industries.
September 2nd: Britain's Aircraft Industry.
September 9th: Farnborough Report.
September 16th: Farnborough Review.

HANDLING the PIPER APACHE

Lightest and Cheapest of the American Light Twins

By C. M. LAMBERT

TWO Piper PA-23 Apaches recently passed through Gatwick Airport on their way from the Piper factory at Lock Haven, Pennsylvania, to Pretoria, South Africa. They were ferried to England by pilots of an American company, Fleetways, Inc., and were taken over by Col. F. C. Ellilt-Wilson and Col. O. G. Davies for delivery to Pretoria Light Aircraft, Ltd., at Wonderboom airfield, Pretoria. At Gatwick, the A. J. Walter Co., Piper representatives in the United Kingdom, removed the extra fuel tanks fitted in the cabin for the Atlantic crossing and prepared the aircraft for the onward flight.

The Apache is the first all-metal aircraft that Pipers have put into production (though not the first such airframe they have built and flown) and it is powered by two 150 h.p. Lycoming O-320 "flat four" engines which are also fitted in the Pacer and Tri-Pacer. In the Apache, Pipers have preserved all the features of simplicity and easy maintenance, and the light-aircraft handling qualities, of their earlier types, while offering a twin-engined machine that will lift its own empty weight in fuel and passengers or freight.

The aircraft has a reasonable wing-loading of 17.2 lb/sq ft, a top speed of 180 m.p.h. and a service ceiling of 10,500ft. It will cruise at 170 m.p.h. at 6,000ft on 75 per cent power and at 162 m.p.h. at 9,000ft on 65 per cent power; consumption is respectively 18.8 U.S. gal/hr and 16.3 U.S. gal/hr. Ranges for these two speeds are respectively 620 statute miles and 710 statute miles, with an extreme range, at optimum power settings, of 840 miles. Fuel capacity is 72 U.S. gal with optional extra tanks in each outboard wing panel holding a further total of 36 U.S. gal.

Single-engined performance is as good as one could wish, with a rate of climb, at full load, of 240 ft/min at 95 m.p.h. and an absolute ceiling of 6,750ft. In fact, a company in South Africa was considering using an Apache for photographic duties, but had to be sure it could work at 20,000ft. They tried the first Apache to be delivered there (it had been flown over *via* the Azores and West Africa by the two Piper sons) and climbed it at full load to 21,000ft. They cut one engine during the descent at 9,500ft and were able to maintain height.

The Apache carries four people and 200 lb of baggage. It has hydraulically operated undercarriage and flaps, steerable nosewheel, hydraulic brakes, cabin cooling and a combustion heater, and can carry a variety of radio equipment and blind-flying instrumentation. The particular example I flew recently, registered ZS-DME, carried a full blind-flying panel, but only V.H.F. radio. The seats are sumptuously upholstered, and I noticed that the lap-straps are anchored to the floor; the baggage locker has a separate hatch on the right side of the fuselage which cannot be shut unless the key is actually turned in the lock to secure it. There is a single entry door on the same side and the front right-hand seat is arranged to slide back or forwards and also to tip forward to leave ample room for entry. In fact this is the easiest aircraft to climb into I have yet met.

I climbed in with Col. Ellilt-Wilson and he showed me the controls. The panel is straightforward and simple, with dual boost gauge and separate r.p.m. gauges, each with built-in engine running-time counter. All indications for fuel, oil and cylinder heads are in small rectangular instruments ranged in neat but not too easily studied rows low down to starboard. Operating ranges and danger levels are marked in the appropriate colours, so that if one knew how to start the engines one could fly the aircraft happily without conversion.

The master battery-switch and starter buttons are carefully hidden under the consoles to prevent casual visitors causing damage. Magneto and fuel booster-pump switches are all in a row on the left, together with sundry light switches. Throttle, pitch and mixture levers are on the central pedestal, all the same shape and colour, but different in length and angle of mounting. Flap and undercarriage levers are below these, distinguishable as an aerofoil section and large plastic wheel. After either has been operated it clicks noisily back to the neutral position when the required operation is complete. Undercarriage position indication is by three green lights which show each unit to be locked down; no lights mean that one or more legs are unlocked, and a single amber light shows that all are locked up. This stays lit all the time, and it is, therefore, difficult to tell which is the offending leg if one fails to lock. Emergency operation is by a hand pump with a retractable handle on the pedestal or, for undercarriage lowering only, by air bottle triggered by a valve under the left-hand seat.

Fuel control is from a small panel between the seats. The two on/off cocks are always left "on," and the priming pump plungers are just ahead of them. Cross-feed pump and heater fuel supply are here also. Trim is provided for elevator and rudder, and both are in the form of coaxially mounted winding handles in the roof, the elevator handle being much longer than the other. Trim position indicators are also up here, close beside the handles.

Col. Ellilt-Wilson primed, switched and started the engines and we taxied straight out. The cockpit is comfortable and the visibility on the ground excellent. The nosewheel is steered with the rudder pedals, and differential brake can be applied by toe pedals, situated on the left rudder bar only. Since the engines are the same as that in the Tri-Pacer (described in *Flight* on August 12th) ground running is limited to 1,850 r.p.m. and four minutes, regardless of indicated oil temperature. We therefore made a brief magneto check and took off straight away.

As the loud click showed that the undercarriage lever had returned to neutral and the wheels were up, we settled to the climb at 28in boost and 2,300 r.p.m. At a few thousand feet we trimmed for cruising at 24in and 2,200 r.p.m. and the airspeed built up to 135 m.p.h. The cockpit was notably quiet and speech was possible without raising the voice. R/T. conversation relayed through the cabin loudspeaker was clearly understandable. A jet of cool air (adjustable for both direction and strength) played on my forehead, and more cool air could be let in over the feet. Ventilation on the ground is not so good, since no ram-air is available and the only opening window is the clear-vision panel.

The Piper PA-23 Apache, ZS-DME, at Gatwick shortly before the writer flew it with its South African pilot.

HANDLING THE PIPER APACHE . . .

I settled comfortably to try the controls. The general feel was not too positive but very steady and the Apache flies "hands off" for long periods. Trimmed at 135 m.p.h., I yawed it 15 degrees or so with the wings level and let go of the control wheel. After a few rapid swings each way, it returned to centre positively without dropping the nose. I rolled it gently and let go; the control wheel returned immediately to neutral and the bank-angle remained without any marked tendency for the nose to drop. This happened when rolling both to the right and left. I then pulled the nose gently up from trimmed cruised by ten degrees or so and let go again. The reaction was as good as one could wish. The nose stayed where it was put until 10 m.p.h. of speed had been lost, and it then dropped gently down. As it slowly passed the horizon again the speed was back to normal and when it stopped at the lower end of the phugoid the speed had increased 10 m.p.h. above trimmed cruise. The phugoid damped out quite soon. This was very much more according to the book than the Tri-Pacer had been.

The rate of roll was not high, but adequate, and the response in attitude to control displacement, similarly, was sufficient but not sparkling. Stick forces were light at all speeds and attitudes.

I next reduced power, experiencing very little trim change, and at about 110 m.p.h. put down some flap and then the undercarriage. Trim changes were very small and control did not change. The normal deceleration and changes of configuration to be made, for instance, during a G.C.A. would give one little trouble from trim changes and ease the task of blind flying.

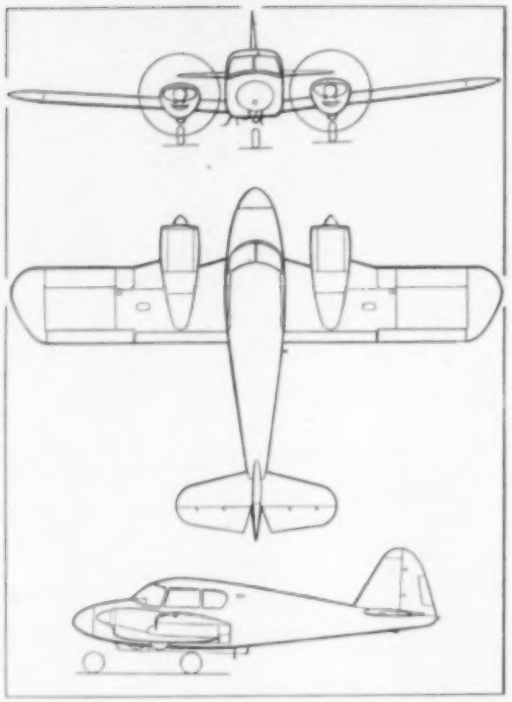
We decided to try some single-engined flying next, and here Col. Ellilt-Wilson explained one of the inconveniences of the aircraft, namely, that the blind-flying instruments cannot all operate on one engine only. A vacuum pump on the starboard engine drives the artificial horizon and D.I. while a generator on the port engine takes care of the turn-and-slip indicator. In case of port-engine failure one loses radio, turn-and-slip and electrics as soon as the battery gives out, but has the D.I. and horizon to fly on. If the other engine fails one has only turn-and-slip and magnetic compass, but the radio remains. It seems that failure of either engine in really bad weather would leave one in an uncomfortable position—but only for lack of instruments or communications and not because of any lack of single-engined performance. But the reliability of the engines has in any case never been called in doubt. Pipers are reported to be modifying the starboard engine to take a generator as well as suction pump.

The pilot throttled back the port engine and pulled its pitch lever back to the feathering stop. The airscrew feathered and magnetos were cut. The speed, with the good engine at 27in and 2,300 r.p.m., dropped back to about 110 m.p.h. and height was maintained without any trouble at all. The aircraft could also be trimmed to fly "hands off." We made one low run over the airfield in this condition, turning steeply to line up with the runway, and climbed away with the speed falling back from 140 m.p.h. At about 600ft in a port turn Col. Ellilt-Wilson relit. The throttle was partly opened, or "cracked" to use the American term, pitch lever moved towards "fully fine," and the starter motor used to turn the airscrew sufficiently to get into windmilling pitch. Then the slipstream took over and after a few seconds the engine was once more running, without the need for idling to warm up again. The oil temperature on the good engine, meanwhile, had hardly increased at all.

The final landing was simplicity itself. Downwind, wheels and flap were lowered and booster pumps switched on. The speed was kept at between 90 and 100 m.p.h., in order to keep on the right side of the single-engined safety speed (95 m.p.h.). The actual touch-down was like that of a very much lighter aircraft; there was plenty of float and good control right down to the touch-down on the main wheels. The nosewheel was put down on to the runway immediately and full control with brake and nose-wheel steering were available. The run was short and quiet, notwithstanding the extremely rough grass of Gatwick's runways.

Altogether, for its size and price (£11,000 in the U.S.A.), the Apache is an excellent machine. It offers twin-engined operational safety and utility combined with a simplicity and ease of maintenance which put it well into the "owner-driver" class. It is also hard to forget the great comfort of deeply cushioned, pleasantly covered seats, excellent sound-proofing and, above all, really efficient ventilation and heating—all this in an aircraft which will carry its own empty weight in fuel and/or payload.

Col. Ellilt-Wilson and Col. Davies left for Pretoria on August 5th, intending to fly *via* Marseille, Tunis, Benghazi, Cairo, the Sudan, Entebbe and Rhodesia. Short of weather hold-ups they hoped to make the flight in about five days. One of the aircraft was to stop at various places on the way through Africa to give demonstrations. Incidentally, Col. Ellilt-Wilson expressed particular appreciation of the assistance given him by Uxbridge and Prestwick traffic control organizations in tracing the progress of the Apaches during their trans-Atlantic flight, at a time when their whereabouts was not known to those awaiting their arrival.



The controls are well laid out with A.S.I. and altimeter clearly visible to both pilots. Flap and undercarriage levers, hydraulic hand-pump, carburettor hot air controls and air-conditioning valves are all on the central pedestal. The small rectangular instruments are oil pressure and temperature gauges and fuel gauges.

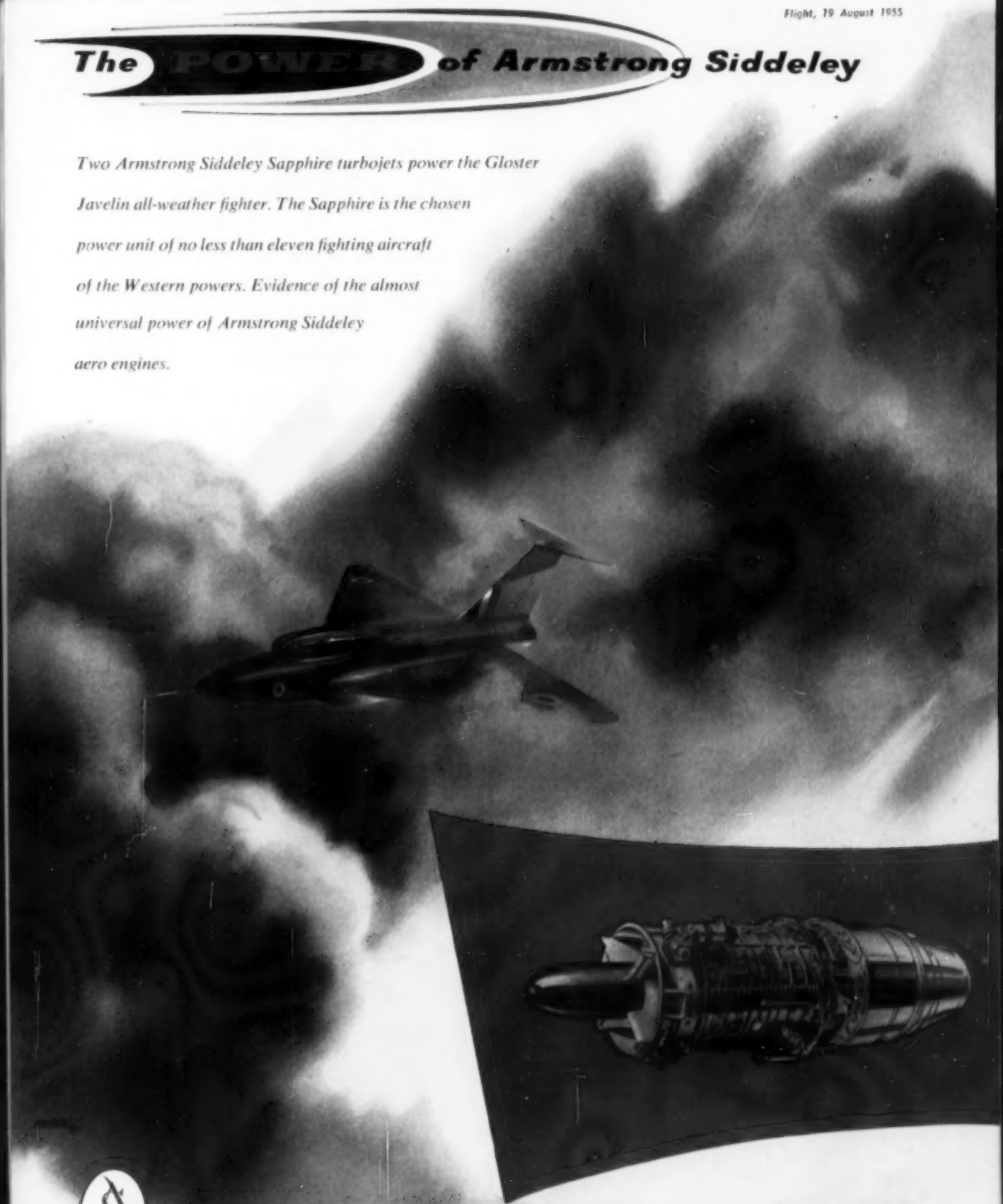
PIPER PA-23 APACHE

(Two 150 h.p. Lycoming O-320 engines)

Span	37ft
Wing area	204 sq ft
Length	27ft 1in
Height	9ft 6in
Empty weight	1,300 lb
All-up weight	3,500 lb
Wing loading	17.2 lb/sq ft
Power loading	11.7 lb/h.p.
Fuel capacity: normal	72 U.S. gal
" extra	36 U.S. gal
(50 gal cabin tank can be fitted in addition to above.)	
Top speed	180 m.p.h.
Stalling speed (flaps, no power)	59 m.p.h.
Cruising speeds, ranges and consumption, without extra tanks: 75 per cent power, 6,000ft, 170 m.p.h., 18.8 gal/hr; 65 per cent power, 9,000ft, 162 m.p.h., 16.3 gal/hr.	
Range at most economical power	840 miles
Service ceiling	10,000ft
Sea-level climb at 76 m.p.h.	1,350 m.p.h.
Single-engined absolute ceiling fully loaded	6,750ft
" " climb at 95 m.p.h. fully loaded	240ft/min
Take-off run	990ft
Landing run	670ft

The POWER of Armstrong Siddeley

Two Armstrong Siddeley Sapphire turbojets power the Gloster Javelin all-weather fighter. The Sapphire is the chosen power unit of no less than eleven fighting aircraft of the Western powers. Evidence of the almost universal power of Armstrong Siddeley aero engines.



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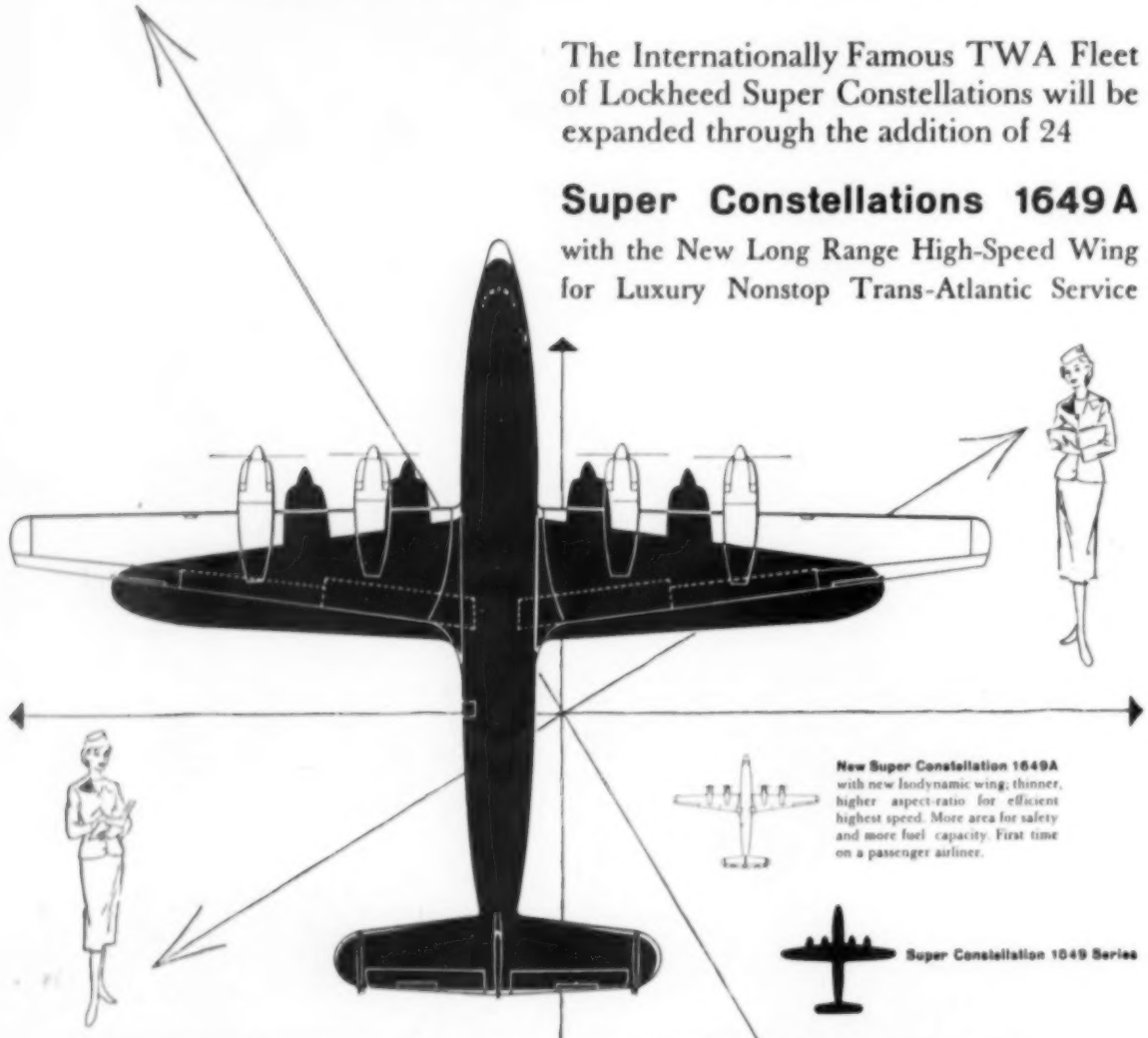
Super Constellations 1649A

with the New Long Range High-Speed Wing for Luxury Nonstop Trans-Atlantic Service



New Super Constellation 1649A with new hodynamic wing; thinner, higher aspect-ratio for efficient highest speed. More area for safety and more fuel capacity. First time on a passenger airliner.

Super Constellation 1049 Series

LONGEST RANGE – 6500 miles. New wing design gives it the greatest range of any airliner ever built. It brings every European capital within nonstop reach of New York.

FASTEST – Top speed will exceed 400 mph. Maximum cruising speed around 350 mph. Point to point speeds up to 70 mph faster than any other piston-powered aircraft at ranges beginning at 4200 miles. The four Wright turbo-compound engines produce 13600 hp, a new high for this type of engine.

QUIETEST – Lockheed designers took two steps to give the plane a new degree of flying quietness. Relocation of the engines five feet farther from the fuselage and use of larger, slower revolving propellers.

LARGEST – Largest wing and longest passenger space of any airliner in service. Carries 58-64 passengers in luxury style.

Lockheed AIRCRAFT CORPORATION BURBANK, CALIFORNIA, USA

HELICOPTER SURVEY

For an African Forest Railway: A Pilot's Impressions

By LEONARD THORNHILL, A.R.Ae.S.

IN the Belgian Congo, for some four years, Sabena operated three helicopters for the *Service de l'Hygiène* of the Congo Government. Then, owing to an expansion of the work programme, the original S-51s were replaced at the beginning of this year by three S-55s, which, in addition to their normal duties, have been made available for charter.

One of these recent charters was for a mining company in French Equatorial Africa, a combination of French interests and United States Steel Corporation, and called "Comilog." The problem facing this company is to link their manganese mine at Moanda, near Franceville, with about 200 miles of railroad to join the Pointe Noire to Brazzaville line at Dolisie.

Most of the country through which the projected line is to run is covered in dense forest—the Gabon—and the survey work was far from easy. One of the problems was that for the last 60 miles the forest was so undulating and threaded with small valleys and rivers, that two alternatives were open: To continue with the railway following a few savannahs, a little to the west of the direct route, or to construct a cableway across the forest connecting with a railhead near a place called Mayoko.

The survey had, after almost two years of work, reached a stage where a comprehensive evaluation and inspection of the proposed route was essential not only for the surveyors but also for would-be contractors, to enable them to form a more accurate appreciation of the difficulties with which they were likely to be faced.

Obviously, the only way to do this was by helicopter. Therefore, early one Sunday morning I set out from Leopoldville across the wide Congo River, in an S-55 registered OO-CWE to pick up passengers (amongst whom was a senior executive of the United States Steel Corporation) at Brazzaville, and from there fly them 190 miles westward to Dolisie, where there is a good airstrip from which Air France operates a regular service. With me was my engineer, M. Van de Zavel.

Our complement of six passengers and baggage onward from Dolisie did not allow my engineer to ride along with us, as we were already at maximum load. Arrangements were made for him to go up by road in a station wagon, to Mayoko, almost due north. Although the distance direct was only 132 miles, it was not until 24 hours later that he rejoined me, somewhat tired and dusty.

The clearing, in trees and 7ft elephant grass, near M. L'Avoine's house at Mayoko. The further clearance at one corner can be seen.

The S-55 takes off with the author at the controls.

Meanwhile, with Mr. George Clemens, Comilog's American consulting engineer, beside me in the co-pilot's seat, we followed at treetop height the route of the proposed railway. The first 50 miles was across the big Niari plain or "Plaine de Dihessé" where large herds of buffalo, frightened by the noise of the helicopter, ran blindly in the tall grass.

It was a magnificent grandstand view of swiftly flowing rivers, waterfalls—their cascading spray almost hidden by the trees—elephants scrambling up from the banks, and native villages whose inhabitants rushed out, puzzled by the strange flapping "bird" above them.

Comilog's survey maps were accurately followed by my "navigator" and in due course we arrived at Mossendjo, about 50 miles south of Mayoko. Here we landed to take in fuel which had previously been sent up by truck. Within a few minutes of landing on this strip, the S-55 was surrounded by hundreds of curious natives. Refuelled, we continued, following the road to Mayoko. Unless we were flying directly over the road and tracing every twist and turn, it would completely disappear from sight, so thick were the trees.

Mayoko, about 2,300ft a.m.s.l., consists of a half-dozen houses built on a small hill by an enterprising Frenchman, M. Toto L'Avoine, who for some years past has been mining gold nearby. Near his house he had cleared a small square of ground, and on this we landed. The patch was surrounded by 7ft-high elephant grass and tall trees.

Having been shown our rooms, we met on the terrace of M. L'Avoine's house for a very welcome drink. The view was awe-inspiring; in all directions, as far as the eye could see, an unbroken carpet of trees stretched away into the distance, merging into the horizon with the gathering evening mists.

The next morning, with the aid of a small caterpillar bulldozer, we enlarged the strip, cutting numbers of trees from one of the corners. Humidity, high temperature, altitude and "no-wind" conditions, plus the impossibility of making a true "running take-off" compelled us to restrict our all-up weight to about 6,850 lb when we left that afternoon to cross the last 60 miles of trackless forest to the mine.

Flying as accurate a compass course as possible, we were rewarded by sighting two emergency landing clearings, which had been made by the ground survey party. After 50 minutes of flying, we arrived at Moanda, which is identifiable by a unique rock landmark, visible for some distance. The mine, situated on the summit of a range of grass-covered hills, possesses an excellent gravel airstrip for its air link with Brazzaville—and a lot of dust.

To our delight, mosquito nets were provided at the rest-house, but we were somewhat disconcerted to learn that they were for protection against large biting spiders, which made their appearance later in the evening. This is typical lion country, and we were shown a fire extinguisher nozzle full of small holes, alleged to have been made by a hungry lion in the night!

During the next few days, we made five trips across to Mayoko and back. On all of these trips my engineer accompanied me because, had any mechanical trouble developed, it would have taken about four days to send a message round by road and then another four days for him to reach us.

On several occasions we landed in the forest 40 km from the mine to pick up and set down members of the ground survey party on their prepared strip. Some photographic work was done with a Fairchild camera fitted in the floor of the 55, and alterna-

HELICOPTER SURVEY...

tive routes were explored at low level with the aid of aerial photographs taken some time before.

The following Thursday we arrived at Mayoko on our way "home," only to learn that one member of the survey party—who had been taken ill whilst awaiting us—had been sent down to Mossendjo by road. With the rest of the party, we immediately followed. Upon our arrival it was decided to transfer the sick man to the helicopter and fly him to Dolisie that evening as he was running a very high temperature. The patient was carried aboard on a stretcher and, with the wife of one of the surveyors acting as nurse, we reached Dolisie just before dusk, where he was taken to the hospital.

Returning to Mossendjo the next morning, the others, led by Mr. Clemens, rejoined us. We then set out once again at low level over the route which had been flown the previous Sunday afternoon, to Dolisie, and thence to Brazzaville.

In six days the helicopter had achieved what no other medium could. It had provided transport from an international airport to the locality and back. It served as a moving platform over 200 miles of route from which the engineers and surveyors could closely inspect not only the track of the proposed line, but also the alternatives, in extremely difficult country where almost the only view on the ground was through a tunnel in the trees. It had permitted a check, from altimeter readings, of the relative gradients and contours of the terrain.

The helicopter, too, had shown several possible short cuts not visible to the men on the ground. It had made possible an evaluation of the whole project in a matter of days to engineers from America, France, Belgium and Sweden, allowing them to be back in their respective countries within the week. It had served, also, as an air ambulance in an emergency.

And for the pilot—25 trouble-free hours of interesting flying.

SMITHS FLIGHT SYSTEM

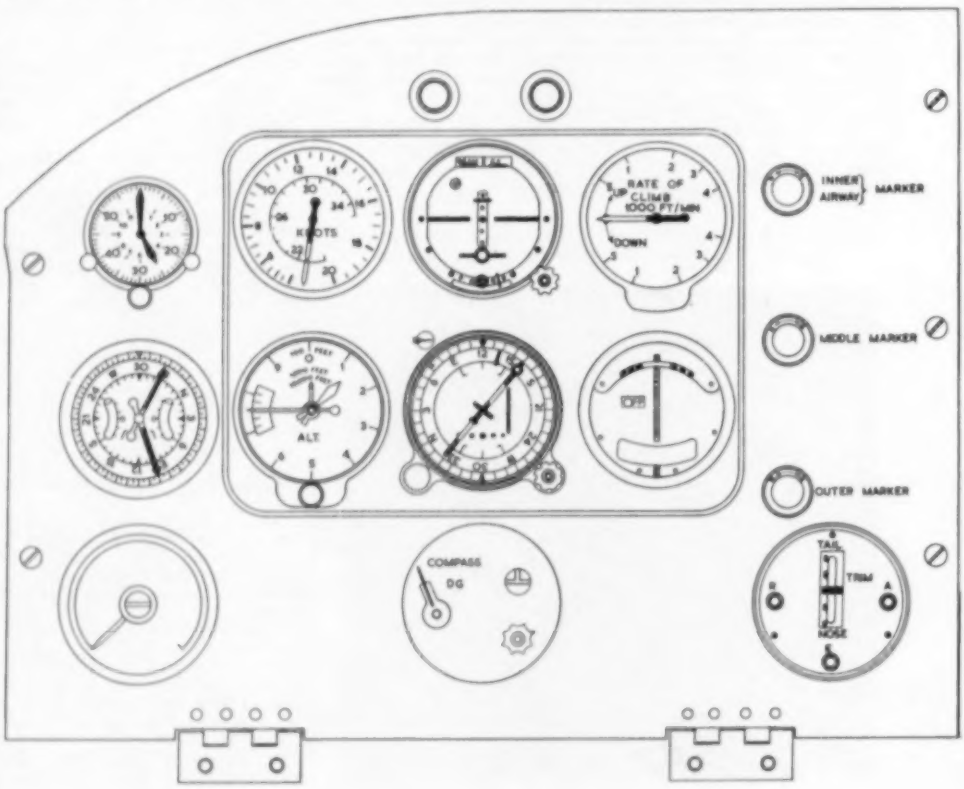
The Britannia's Director/indicator Instrumentation

PROBABLY the most advanced blind-flying and navigation instrument system yet produced is the Smiths Flight System, preliminary details of which have just been released by Smiths Aircraft Instruments, Ltd. The system has been developed over the last year, to give the pilot combined attitude reference and instructions for using information supplied by navigation radio. In addition it is designed to be used as the director function for the Smiths S.E.P.2 autopilot, and also for course holding through precision directional gyros used in Polar flying. B.O.A.C. have been consulted during development and the system will be installed in the Britannias. B.E.A. also will probably specify it for Viscounts now on order. The first complete S.F.S. is now fitted in Smiths' Anson for final evaluation.

Altogether the functions of sixteen instruments have been combined in eight standard-size panel-mounted indicators, two of which (illustrated on p. 255) are the main directors for instrument flight with radio aid guidance. They are respectively the beam compass and director horizon. The instruments are intended to be duplicated on the two pilots' panels and arranged so that a failure on one side will not affect the working of the other side. Particular emphasis has in fact been placed on safety, and effective warnings are applied to cover any possible fault or misalignment. Switching and setting operations have been reduced to the absolute minimum in order to simplify the pilot's task when following complex traffic patterns. Although designed to operate integrally, individual units can be supplied separately for special applications.

The Smiths Flight System provides the following facilities (1) duplicated indication of aircraft attitude in a manner similar to that of normal artificial horizons, (2) duplicated indication of aircraft magnetic heading from two independent gyro-magnetic compass systems, (3) repeated magnetic heading information for other equipment, such as an R.M.I., (4) duplicated presentation of I.L.S. and V.O.R. displacement information related to the heading of the aircraft to give a complete plan picture, (5) duplicated flight director control by attitude demand signals for bank and pitch superimposed on the artificial horizon picture, (6) full facilities, when linked with the Smiths S.E.P.2 autopilot, for course steering, turns onto preselected headings, maintenance of pre-set pressure altitude, airspeed monitoring, V.O.R. radial tracking and fully automatic approach on I.L.S., (7) duplicated course-selection common to both autopilot and flight director on primary compass indicators, (8) common function-selection for radio coupling in both autopilot and flight director, including selection of port or starboard compass system for heading control, and selection of radio facility to be used. A E2.A stand-by magnetic compass is included in the system.

There are two major units in the system; the S.E.P.2 autopilot, which uses only magnetic amplifiers and provides radio-coupling,

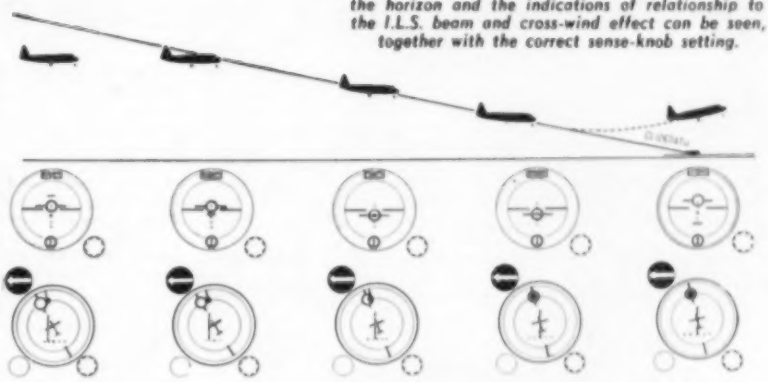


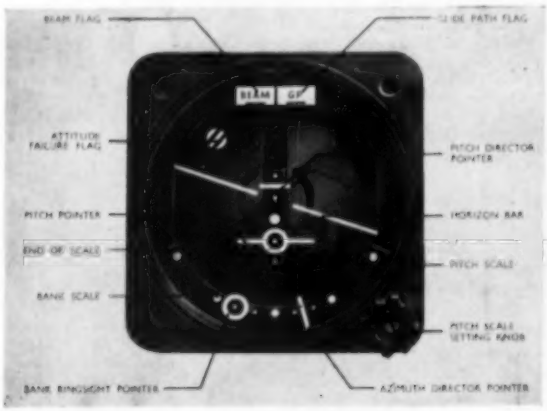
The captain's panel for the Britannia, showing how the Smiths Flight System is laid out. In the central panel, reading from right to left, are the A.S.I., director horizon, V.S.I., altimeter, beam compass and turn-and-slip indicator. Round this panel, reading anti-clockwise, are the clock, radio-magnetic indicator, D.M.E., compass control panel, autopilot trim indicator and the three I.L.S. and airways marker lights.

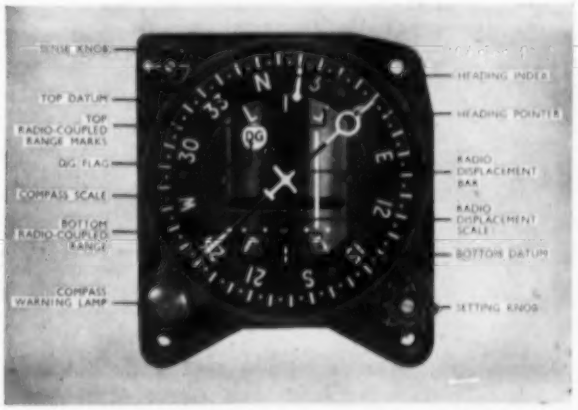
approach-coupling, and height and air-speed monitorings and the Smiths Twin Compass. In the latter system the two gyro-magnetic compasses are linked to cross-monitor each other, and a signal arranged to give warning when their readings differ by more than a certain number of degrees.

The director horizon combines the functions of attitude indication relative to a desired fore-and-aft pitch attitude, and steering and pitch instruction for following such aids as I.L.S. or V.O.R. Lateral attitude is shown by the horizon bar and bank ringsight pointer in the same way as in an artificial horizon. The horizon bar, however, does not move up and down, as is normally the case. Pitch attitude is indicated by the relative position of the horizon bar and the pitch pointer, whose bar represents the traditional miniature aircraft. The pitch scale can be adjusted by means of the pitch-scale setting-knob to give an attitude

Instrument indications during an I.L.S. approach with the Smiths Flight System. The director functions of the horizon and the indications of relationship to the I.L.S. beam and cross-wind effect can be seen, together with the correct sense-knob setting.







(Left) The director horizon which, as described in the text, provides attitude indication combined with steering and pitch directions derived from the beam compass. (Right) The beam compass indicates the aircraft's magnetic heading at all times, allows the pilot to select a desired course, and shows him his position relative to a beam or V.O.R. radial.

neutral datum as dictated by various factors such as the aircraft's weight distribution. The director functions are vested in the pitch director pointer, which indicates where the pilot should put the pitch pointer to follow the glide-path, and by the azimuth director pointer, which tells him which way he should bank (and therefore turn) to line up with the localizer beam or V.O.R. radial. In the illustration the aircraft is left wing low and nose down, and the directors are calling for the nose to be pulled up and the course altered to starboard.

The two flags marked "beam" and "GP" (glide-path) come out, as in the photograph, and remain steady as long as the two functions are working properly. Should either fail, or the signal strength fall too low for proper operation, the appropriate flag will begin to oscillate. The attitude-failure flag, too, remains steady when all is well, and oscillates when something is amiss.

The beam compass combines information in a rather similar way, and gives a type of plan presentation of the aircraft's heading relative to I.L.S. beams or the V.O.R. radial selected by the crew. The aircraft's heading is at all times indicated by the heading pointer against the appropriate figure on the graduated compass scale; but by pushing the setting knob and turning it the compass scale can be rotated to bring any desired heading up into the 12 o'clock position. By pulling and turning the setting knob the heading index can be rotated on to a desired heading so that the director horizon will give instructions for turning on to that heading. The heading chosen may be simply a new course, or a desired V.O.R. radial (when turned to a V.O.R. beacon) or the QDM of an I.L.S. localizer. Turns of 180 deg should be made by resetting the heading index twice, not more than 150 deg at a time. The radio displacement bar will indicate where, relative to the aircraft, a V.O.R. radial or I.L.S. localizer beam lies, and the scale just below it shows how far away it is. The bottom and top datum scales indicate the sectors in which the system locks on to follow a beam or radial, and the sense knob at top left must be set to achieve the correct type of beam following. The compass warning light shows when the two units of the twin compass are out of alignment with each other by more than the permissible number of degrees.

If an I.L.S. beam heading is set in the 12 o'clock position on the dial and the system is locked on and being used either for manual flying or with the approach coupler, drift due to cross-wind can be compensated for by offsetting the heading index by the right number of degrees.

The flag marked "DG" (directional gyro) appears if the gyro-magnetic compass has been switched to function as a plain directional gyro. As with the standard gyro-magnetic compasses, failure of the magnetic element can be overcome by using only the gyro component of the instrument and monitoring it with a plain magnetic compass. "DG" is selected on the compass control panel, where the annunciators are also located.

NEW HELICOPTER INSTRUMENTATION

A CONTRACT for the long-term development of a rational helicopter instrumentation system has been awarded to the Texas division of Bell Aircraft Corporation by the U.S. Navy. This is similar to fixed-wing project allotted to Douglas by the same Service, some results of which have already been published (*Flight*, April 8th). Bell will be the co-ordinating authority for numerous research projects, sub-contracted by them, with the object of arriving at an instrumentation system based on human rather than mechanical principles. Controls and other items are included and, since some of the research already completed by Douglas applies equally to helicopter cockpits, it will be made available to Bell.

Broadly, the aim is to establish what information is wanted and how it should be presented; it is not in the immediate project to consider how the equipment can be built. Helicopter instruments must indicate hovering attitude, rotor position and speeds varying from 150 m.p.h. forwards to 20 or 30 m.p.h. backwards. The initial contract is for one year, but the whole project will last several years.

Pictorial Maintenance Schedule

ENGINEERS of Field Aircraft Services, Ltd., have developed a "pictorial maintenance schedule" for the Hunting Clan Viscounts which they maintain at their new base at London Airport. The chief advantages claimed for the system are that it leads to more thorough inspection by telling the engineers quickly and clearly where the parts to be inspected are located in the aircraft, and by explaining concisely what should be done to them. It also eliminates the repetitions and complications of the conventional written work sheets and manuals, thus saving much paperwork.

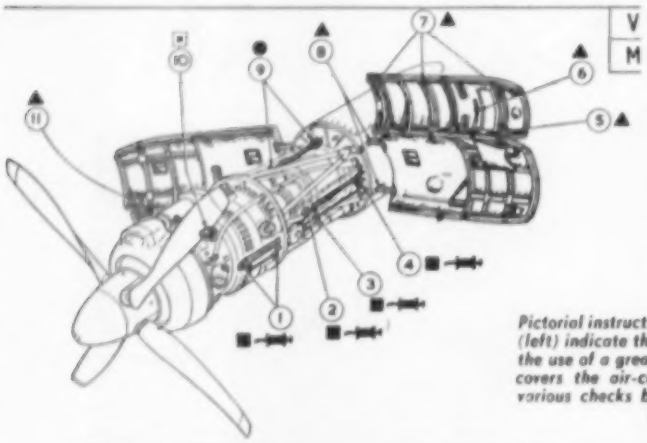
A group of 70 pictorial charts covers the whole of the Viscount and all its systems, and each chart is annotated with a series of abbreviated instructions coupled with the number of the check during which they have to be carried out. Master charts are bound in books and enlarged copies are held in a special desk in the hangar for reference during work.

During each check the inspector signs for a chart at a time on sheets made out for this purpose. For a Check 4, for example, there would be five sheets, one for the 59 airframe charts, one for each engine and one for the charts covering electrics.

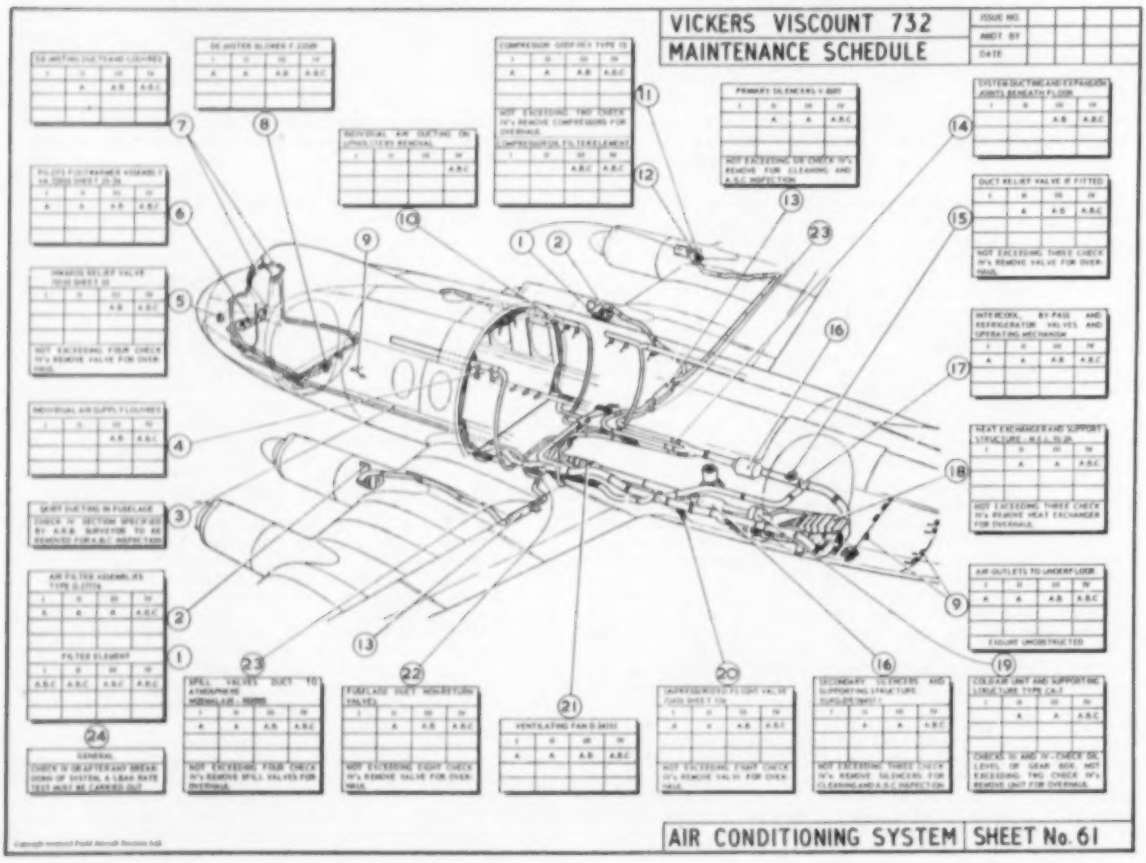
Functional checks required for each component are listed in an appendix to the charts which is covered by a comprehensive index. Also detailed are the minimum number of cover plates and panels which have to be removed for any particular check. Work can be carried out solely by consulting the charts and without the use of work-sheets. The new system has been approved by the A.R.B.

The pictorial maintenance schedule has been fairly costly to produce, but Field Aircraft Services, Ltd., can make it available to other operators on a service-rental basis, under which arrangement Fields would be responsible for all modifications and sheet replacements when necessary.

Various methods and degrees of illustration have been tried before, but this is the first time that a manual has been entirely pictorial. The increases in speed, accuracy and thoroughness in routine maintenance which result are a real step towards simplifying and speeding up the task of inspecting aircraft of increasing size and complexity.



Pictorial instructions for lubrication of components in the engine nacelle (left) indicate the types of oil or grease by the shape of the marks, and the use of a grease-gun by an appropriate silhouette. The chart below covers the air-conditioning system, the inspections to be made at various checks being indicated by standardized abbreviations in the boxes around the edge of the chart.



Over seas oversea

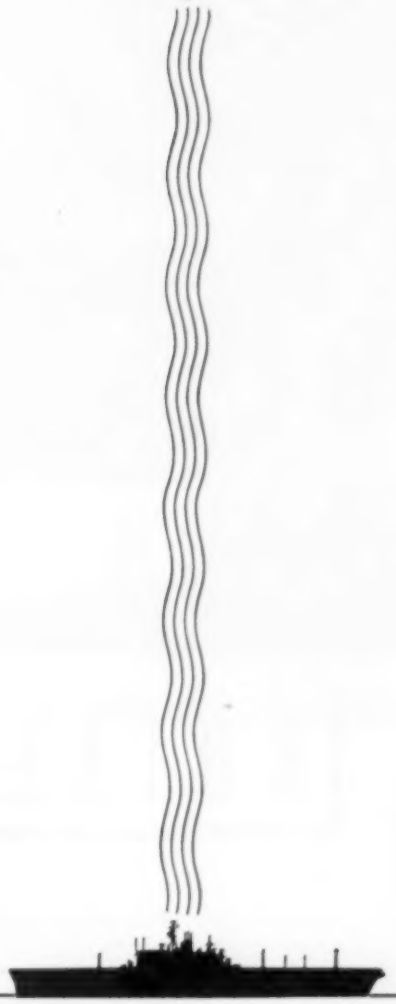
in the line of duty

Fairey Gannets, now in H.M.S. *Eagle*, will be operating in training exercises over Mediterranean waters, where British sea power has so frequently been displayed in the past.

The Gannets thus take up another of their destined roles—guardians of the Fleet and the merchant ships against submarine attack. From carrier deck or shore base the "eyes of the Fleet" are flown confidently—the Double Mamba engine installed exclusively in this aircraft gives double assurance of operational efficiency and safety.

FAIREY

GANNET



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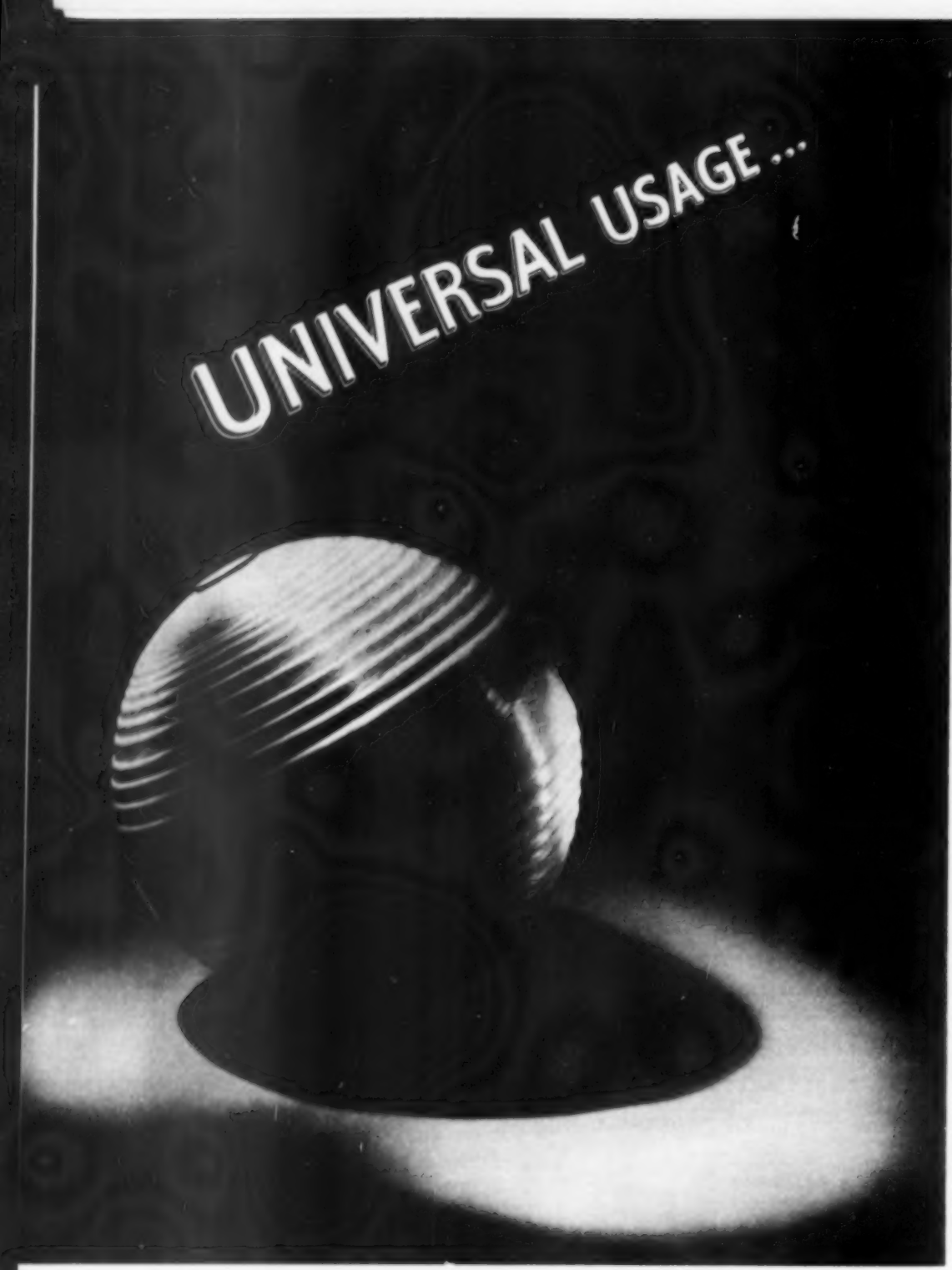

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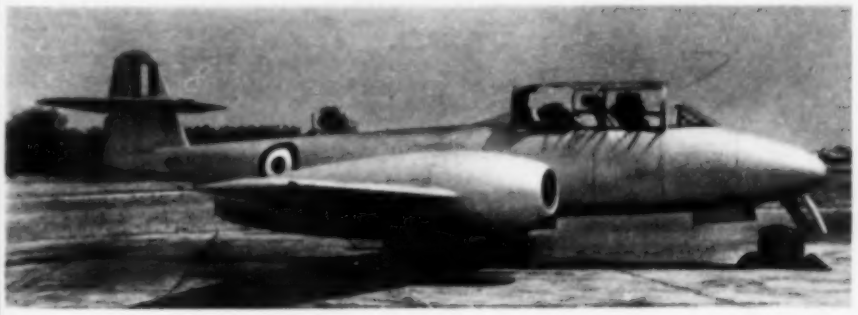


The Convair XF2Y-1 Sea Dart, on the left, is distinguished from its predecessors in having a single retractable hydroski. Earlier machines had two skis. The Meteor is a Mk 7/8, used by Martin Baker for ejection-seat tests.

AIRCRAFT INTELLIGENCE

U.S.A.

Convair B-36 with Nuclear Reactor. A special B-36 is now being prepared by Convair to carry the first airborne nuclear reactor for shielding tests. It is distinguished from standard machines by heavy shielding around the cockpit portion.

U.S.A.F. Development Contracts. Six development contracts have been awarded by the U.S.A.F. in the long-range intercepter, fighter/bomber and tactical bomber categories. The long-range intercepter proposals are by North American, Northrop and Lockheed, the North American being the F-107 (originally called the F-100B), the Northrop a delta development of the F-89 Scorpion, and the Lockheed a new straight-wing design. U.S.A.F. specifications for the new intercepter called for Mach 2 performance and a combat radius of 1,000 miles. Republic and North American have received contracts for a fighter/bomber, and Martin and Douglas for a tactical bomber.

Pantobase YC-123. First illustrated in *Flight* last week, this development of a C-123 assault transport by the Stroukoff Aircraft Corporation has retractable hydroskis. The fuselage has been made watertight and lateral stabilizing floats are fitted beneath the wings. Airscrew diameter has been slightly reduced. A U.S.A.F. contract for six more aircraft is in hand, and these will furthermore have boundary layer control features now being tested in another prototype, the XC-123D.

France

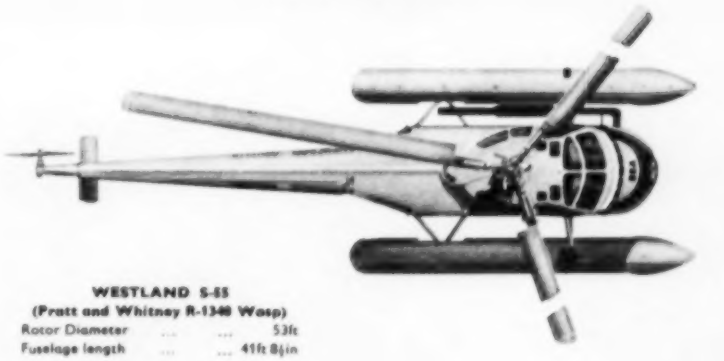
Hurel-Dubois H.D.35. An order for three of these long-endurance anti-submarine aircraft has been placed by the French Navy, seemingly pointing towards quantity production. Arrangements have accordingly been made by S.N.C.A.S.E. to set up a production line. The three prototypes will be built by Hurel-Dubois at Villacoublay.

S.O.1221 Djinn. Modifications incorporated in the S.O.1221 Djinn helicopter—in particular an increase in rotor diameter from 32ft 10in to 36ft—has enabled the payload to be raised by 132-154 lb without altering the performance figures. It was recently reported in the Argentine that negotiations are under way between the Argentine Government and S.N.C.A.S.O. concerning the purchase of several Djinns for civilian use.

Marcel Dassault 550. This delta-wing intercepter (two Dassault/Armstrong Siddeley Vipers), which was first flown on June 25th, has made five test flights with Roland Glavany at the controls. Flying will be resumed at the end of August.

Czechoslovakia

Zlin Z-26 Trener 2. For some years the Zlin Z-26 Trener has given good service in Czechoslovakia and Poland. A new version, known as the Trener 2, has now been developed. The engine is the Walter Minor 4-III inverted air-cooled unit. Cruising speed is about 111 m.p.h. and take-off run 186 yd.



WESTLAND S-55
(Pratt and Whitney R-1340 Wasp)

Rotor Diameter	... ...	53ft
Fuselage length	... ...	41ft 8½in

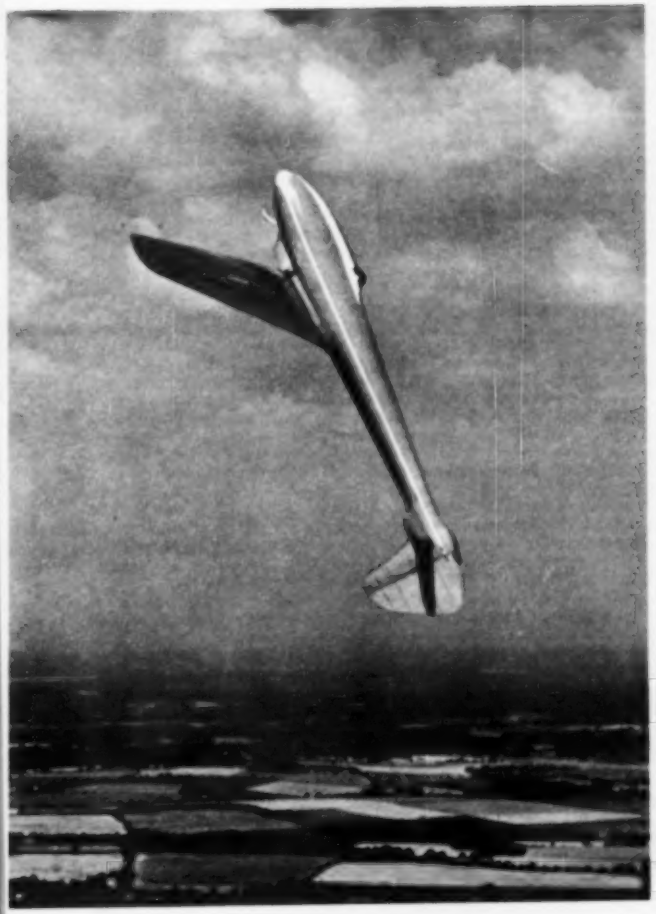
AIR AND

THE two elements in their kinder moods form the theme that links these pleasant pictures. Warm summer air under blue skies, in which a formation of aircraft disports itself; summer air forming a heat-haze as a background to a sailplane's aerobatics; water, ice-clear and deep, where trout rise to the fly as purposefully as the glistening machines thrust skyward.

The mixed bag of aerobatic aircraft are a NATO team which got together for the first time at the recent Metz meeting. Leading the unrehearsed formation is a Hunter of No. 54 Sqn., flown by Capt. Richard G. Immig, U.S.A.F., serving with the R.A.F. on exchange posting; on each side are Sabres of the R.C.A.F. "Sky Lancers" team (F/O. L. N. Eisler and F/O. B. R. Campbell); in the box is a T-33 of the "Acrojets" team from No. 7330 Training Wing, U.S.A.F. (Capt. R. W. Jellison). Inverting the Olympia sailplane is Derek Goddard of the Surrey Gliding Club, who thus entertained spectators during the National Gliding contests.

The trout-fishing pictures, in which are Bellanca and Fairchild floatplanes, were taken at a hunting lodge, and at various lakesides, in Alaska; and in another part of North America the ubiquitous helicopter has been pressed into the sportsmen's service: their craft is a pontoon-mounted Bell 47; their quarry the wall-eyed pike.

WATER



HANDLEY PAGE HERALD

Thought and Practice Behind Britain's New Branchliner

TO each new British transport aeroplane of post-war years some adjective, appropriate or not, has been affixed. Thus, the Elizabethan was to everyone elegant; the Britannia is majestic — and the Handley Page Herald workaday. This deliberately unglamorous description of the Herald was, we suspect, bestowed by Sir Frederick himself. Certainly it was he who, on a recent occasion, said, "We have endeavoured to make something which has a comparatively slow landing speed, has a good get-off, and has economical operation at the speed at which it is going to fly, and in addition is robust and easy to maintain. That I think can be summed up in the words that we have been looking for a workhorse in the air." It was on the same occasion that Sir Frederick said, "If your only competitor is an ox-wagon, you don't need to go through the sound barrier to convince your potential passengers that it is much better to go by air than go by ox-wagon."

Equally apposite were the remarks of G/C. R. C. M. Collard, Handley Page sales manager, who said of the Herald, "It is intended to do the work which is today being done by the DC-3. Directly you look upon it from, shall we say, a European standpoint, I think you will miss the point, because for one thing in Europe the facilities are so good that you can operate almost any aeroplane; and for another thing, in Europe practically nobody flies. Of course, they fill the seats, but they're roughly the same people all the time . . . What we must think of are those areas of North and South America, of Africa, and of Australasia, where transport is an essential part of the life of the community and where everybody flies. In other words, one must consider this problem more from the point of view of, shall we say, an advanced air minded Peruvian Indian rather than a pedestrian and largely earthbound European."

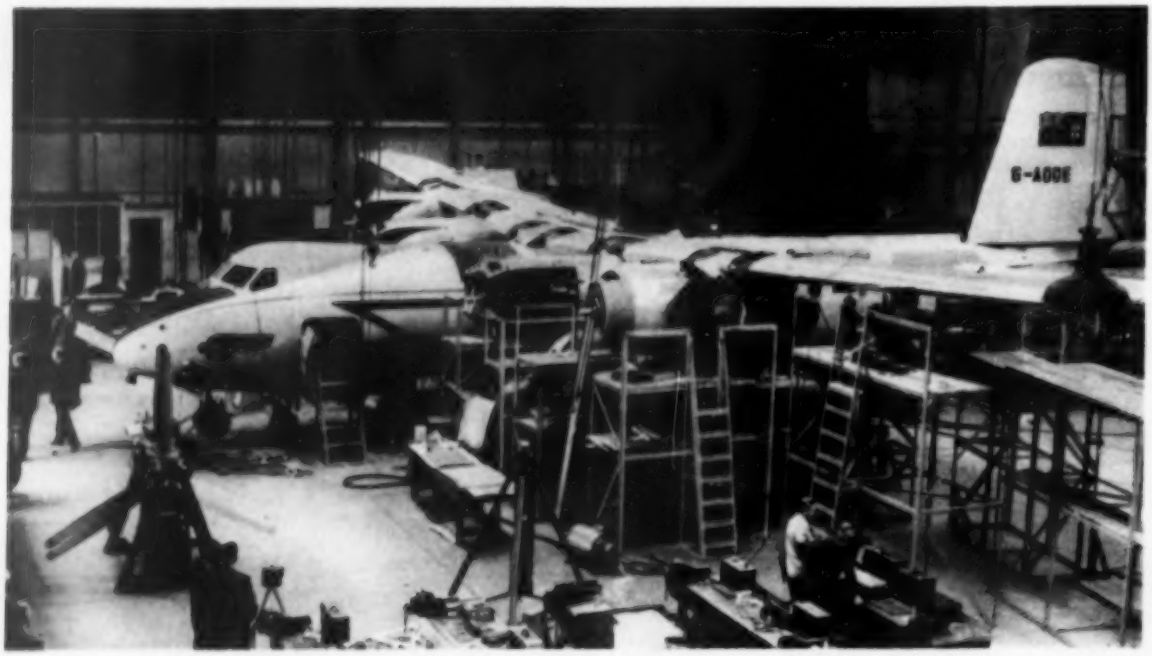
G/C. Collard added: "Of four engines, I need only say that they are there for safety. That's the main and really the only argument. Whatever may be said about a two-engined layout—and it has many advantages—we all know that if you have a failure on a two-engined aeroplane you've lost half your power, and you are faced with a crisis at once . . . On a four-engined aeroplane, if you lose one engine it is no more than an incident. Then the engines are piston engines. There are many reasons for that, but they can be all summed up in this: they are piston engines to enable the owner and the operator to make money. It is no use saying that local services can be operated by a larger line in its spare time, on the side, make a loss and make it up on the long hauls. If that were so, then aviation would slowly die over a great part of the globe. Local services branch lines can be operated with profit, but only if you have the right aeroplane."

And while citing the views of Handley Page personalities we may well recall the words of Mr. T. C. Wallace, of Alvis, Ltd., makers of the new Leonides Major engines with which the Herald is powered: "At Alvis, we are particularly conscious of the difficulties of an aircraft constructor who offers a new aeroplane with new engines. It is so well known that the operator, while welcoming the economic advantages of modern airframe design, is invariably suspicious of new engines. It is fortunate perhaps for the progress of aviation, and indeed for the engine constructors and designers, that some aircraft constructors have the confidence and courage to use what the operator regards as a new engine. But we ourselves do not think of the Major as new. We regard it as a bigger and better Leonides. After all, the bore and stroke of the engines are the same. The cylinder, piston and valve arrangements are essentially the same, and these cylinders in Flying Training Command alone have built up a total of no less than one million flying hours. That figure does have the immense advantage that it gave the Major benefit in quick development since the cylinder assembly is always one of the slow features in a new engine."

It will have been gathered that the thinking behind the Herald is deep and clear. Certainly Handley Page spared no pains to elicit the viewpoint of operators in Europe, Asia, Africa, Australasia and South America. Indeed they sent G/C. A. F. (Bush) Bandidt as Sir Frederick's personal representative to visit nearly every airline in the world to search for the answer to the re-equipment problem of the short-haul operator. The outcome of their deliberations and designs is thus an eminently practical aeroplane, holding such promise that several months ahead of the first prototype's maiden flight (now imminent) the makers had announced orders for a total of 29 Heralds—by Australian National Airways, Queensland Airlines and Lloyd Aero Colombiano.

The Herald's wing comprises a centre-section, two outer panels and two tip panels. In the centre-section the skin is a metal sandwich, composed of a corrugated filler spot-welded to inner and outer skins. There are no heavy spar booms, so that the sandwich skin-panels carry bending and end loads. Handley Page

The Herald nears completion: a "Flight" photograph taken last week at the Radlett works.



foresee that avoidance of highly stressed booms, susceptible to fatigue, will greatly increase the life of the wing. Shear loads are taken by three lightly loaded web members. The outer wings are attached to the centre-section by numerous bolts which carry the load from the outer wings into the sandwich skin-panels.

The centre-section comprises a centre box, leading edge and trailing edge. The centre box has a corrugated metal sandwich-skin and three vertical webs, the centre web being a corrugated metal sandwich and the other webs built up of stiffened light-alloy plate. This form of construction effectively reduces the number of ribs required; in fact, the only ribs are those at the load-carrying attachment points, namely the centre-section-to-fuselage attachment, nacelle and undercarriage pick-up points, and wing joints. The centre-section is attached to the fuselage by rigid fittings and hinge-links on the front and rear webs, ensuring that wing deflections are not transmitted to the fuselage.

Normal stressed-skin construction is used for the outer wings, each of which has two webs and pressed diaphragm ribs. The skin over the leading edge is spot-welded to shallow members having chordwise corrugations, and a gap of approximately 0.1in between the corrugations and the skin is used for the distribution of hot air when a leading edge anti-icing system is installed. The trailing edge has a false spar to accommodate the flap shroud and closely pitched riblets covered by a single skin. The centre box in the centre-section, outboard of the inner engine nacelle, houses the fuel tanks, and space is available for additional tanks at the root of the outer wing. Housed in the leading edge, forward of the centre box, are the engine and aileron controls, electrical wiring, and cabin heating and pressurization ducts. The flap controls, hydraulic pipelines, fuel lines and pressure-head piping run behind the centre box. Hinged doors in the under-surface of the wing give access to the controls and service-piping runs.

The ailerons extend from the outboard ends of the metal-covered Fowler flaps to a point 15in inboard of each wing tip. Each is mass-balanced by a weight carried on an arm operating within the tip itself, and aerodynamic balance is achieved by geared tabs and an internal forward balance. Each aileron has a spring tab and in the port one is a trim tab.

The fuselage is of stressed-skin construction and of constant section over the greater portion of the cabin. The cross-section is formed by two circles intersecting on two chine beams running longitudinally at floor level. Below these beams construction utilizes top-hat section stringers and pressed frames, the frames supporting the floor; above, top-hat stringers and Z-section frames are employed. The skin panels are spot-welded to stringers which are in turn pop-riveted to the frames. Supporting the wing are two box-section main frames of sufficient strength to withstand belly-landing loads. There are three main bulkheads. One, at the aft end of the cabin, and another, at the forward end of the cockpit, are pressure bulkheads; the third forms the rear of the cockpit. Extending the whole length of the cabin are two top-hat-section floor beams, carried on top of the lower-frame pressings, and carrying the inboard anchorages for the seats. Outboard anchorages are carried on members between the frames at the cabin wall above floor level.

In the port side of the fuselage are doors for crew, passengers and freight. The crew door is just behind the cockpit, which is entered through the radio and freight compartment. A large double doorway at the rear of the fuselage is for the handling of freight; only the forward half is used for passenger entry. Between the frames and on both sides of the cabin are circular windows, having dry-air insulation to prevent misting. Each pane can withstand the full pressurization load. There are two escape hatches on the starboard side, the forward one measuring 2ft 9in high by 1ft 10in wide, and the rear one (which extends to the cabin floor) 4ft 2in high by 2ft wide. The cockpit canopy comprises five flat window panels, the side windows being arranged to slide for direct vision.

The fuel cross-feed pipe runs over the fuselage, inside the wing. Electrical and hydraulic services are kept apart; electric cable-runs are in the roof; and hydraulic pipelines under the floor, as are the elevator and rudder control runs. Aileron and engine controls and hot-air and pressurization ducts are in the fuselage roof. Removable panels in the ceiling and floor give ready access to the services.

The use of fluted skin renders construction of the tail extremely simple, for internal structure is reduced to a minimum. The effect on drag is negligible. Each tailplane sub-assembly is built round three spars with fluted light-alloy skins and pressed light-alloy sheet ribs; each elevator has two spars, main and nose rib, a tab-attachment member, and a tip fairing. Here again, covering is fluted light-alloy. The fin is built up from spars and pressed light-alloy sheet ribs, and it too has a fluted skin. The spars are bolted to the attachment bulkhead at the rear of the fuselage. Similar in construction is the rudder. The leading edges of the fin and tailplane have shallow chordwise corrugations beneath the outer skin to act as distribution ducts for hot air when the anti-icing system is installed.

The Herald's main undercarriage legs retract forward, as shown, into the inboard engine nacelles.

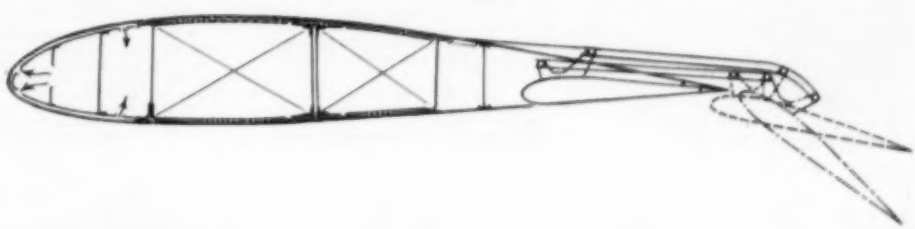
The elevators have sloping horn balances and are joined by a torque tube. Aerodynamic balance is by geared tabs and an internal forward balance. The port geared tab can be mechanically operated for trim by the pilot. The rudder also has a sloping horn balance to contain the mass-balance weights, and this, too, is aerodynamically balanced by means of geared tabs and internal forward balance. There are two tabs, one above the other; both are geared balance tabs, but the upper one can be mechanically operated for trim.

All three units of the Electro-Hydraulics undercarriage have single oleo pneumatic struts, with twin wheels mounted on stub axles and all are locked in their extreme positions by hydraulic jacks. The main units are hinged from forgings attached to the mainplane rear web and ribs, and each is stayed by a drag strut secured to the mainplane front web and ribs. The units retract forward into the inboard nacelles. The nosewheel unit is of simple cantilever type and retracts forwards into an unpressurized bay in the nose; it can be steered hydraulically by a wheel on the control column through an angle of plus or minus 55 deg, and has an hydraulic self-centring mechanism and can be released, by a spring-loaded catch, to castor through 360 deg. The wheels have hydraulic disc brakes and the tyres are of low-pressure (50 lb/sq in) type, to permit operation from grass runways. Wheels, tyres and brakes are of Goodyear manufacture.

The undercarriage is lowered and retracted by a gated lever operating a solenoid selector. Inadvertent retraction when the aircraft is on the ground is prevented by an electrical switch on the undercarriage leg. Three flap positions—up, take-off and landing—are possible.

The four Alvis Leonides Major engines are attached by dynafocal mountings to a frame which, in turn, is attached to the nacelle at four points on the fireproof bulkhead. Each cowling has four petals—two large ones at the side and smaller ones at the top and bottom. The bottom petal is hinged across the fireproof bulkhead, but the other three are hinged behind the bulkhead. Fastening is by quick-release toggle fasteners, and opening of the side petals gives access for normal servicing. Just behind the engine induction casing is a fireproof shoulder cowl, in order to protect the accessory bay and piping from fire hazards. A fireproof flexible seal makes contact with this cowl and the petal

(*Continued on p. 264, after double-page cut-away drawing of the Herald*)



Flap in take-off and fully down positions. Also indicated here is the hot airflow of the (optional) leading-edge de-icing system.

HANDLEY PAGE

KEY TO DRAWING

Fuselage

1 Transport joint.
2 Top-hat-section stringers spot welded to skin.
3 Seat rails.
4 Removable floor panels (under-floor access).
5 Main frames.
6 Wing to fuselage pick up.
7 Frames uncut.
8 Hinged panels, full length of roof.
9 Rods carrying stringer stress through centre section.
10 Main roof rail carrying roof lights.

Fin and tail

11 Fin attachment.
12 Corrugated skin (all tail surfaces).
13 Tailplane attachment.
14 Centre spar floats through fuselage.

Mainplane

15 Corrugated-sandwich centre web.
16 Corrugated-sandwich top and bottom booms.
17 Tank fillers.
18 Fuel contents units.
19 Cords lacing flexible tanks to top panels.
20 Z-section outer wing stringers.
21 Removable c'ps.
22 De-icing air outlets.
23 Outer wing joint.
24 Undercarriage.

Cabin air

25 Intake to cabin supercharger.
26 Supercharger and silencer (air via spill valve and heat exchanger to cabin).
27 Non-return valve in duct from nacelle to cabin.
28 Main roof duct.
29 Cabin distribution duct.
30 Air piped to floor level duct.
31 Air to cockpit and windscreen de-misting.
32 Cockpit air louvres.
33 Mass-flow control.
34 Main discharge valve.
35 Inwards relief and safety valves.
36 Pipe from pressure controller in cockpit.
37 Individual punkah louvres.

De-icing

38 Intake to heat exchanger.
39 Control valve, exhaust to heat exchanger.
40 Heat exchanger.
41 Crossfeed and supply to tail surfaces.
42 Distributing corrugations, spot-welded to skin (all leading edges).

Power units

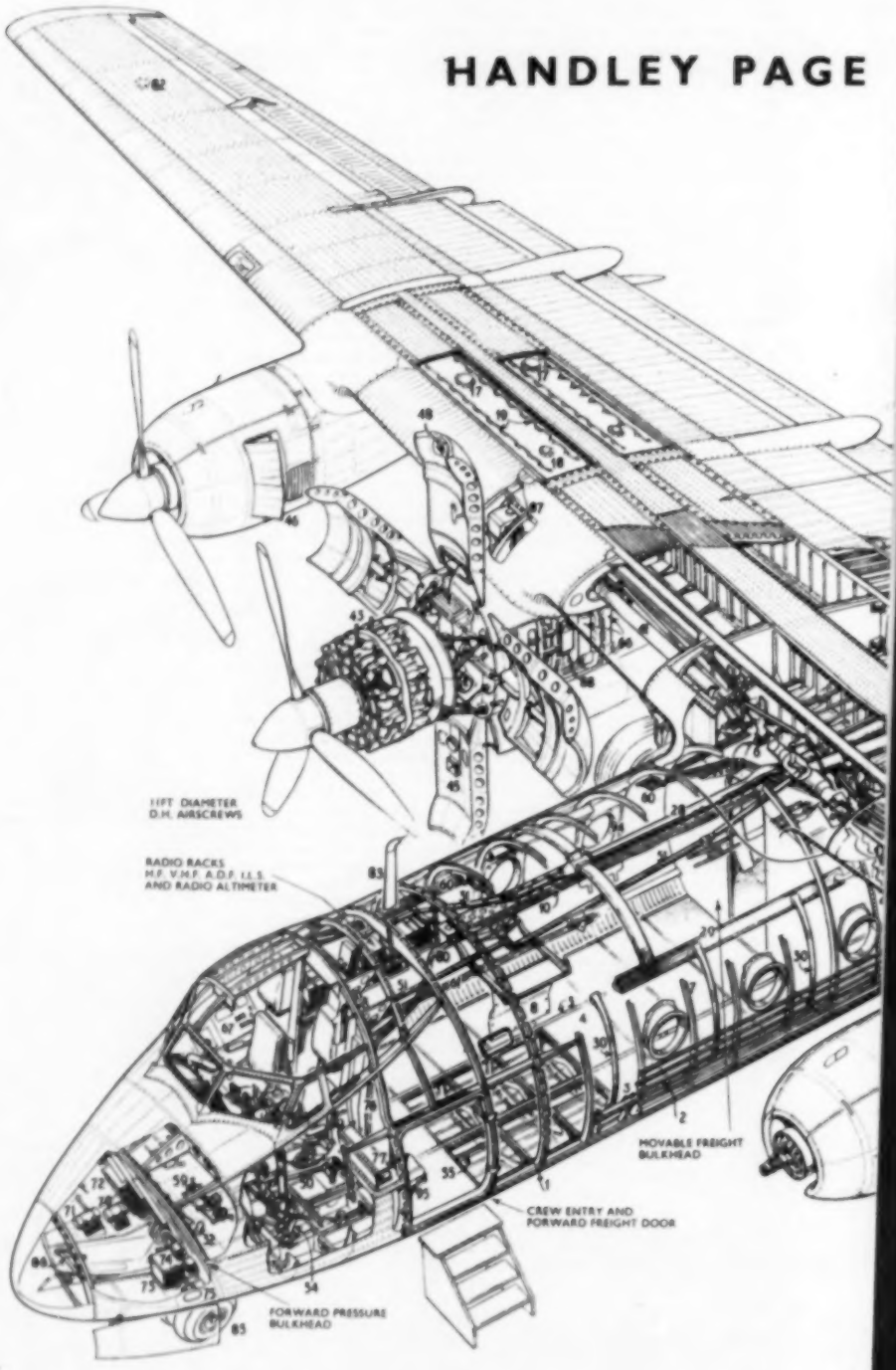
43 Breathers.
44 Oil coolers.
45 Hot- and cold-air intakes, filters and blowback valve.
46 Engine cooling air gills.
47 Fire-suppression rings.
48 Oil cooler air duct.
49 Oil tank (all nacelles, total cap. 40 gal).

Controls

50 Aileron torque rod from column cross-shaft.
51 Aileron push-pull rods.
52 Aileron spring tab torsion bar.
53 Aileron mass balance.
54 Rudder and elevator levers.
55 Rudder and elevator tension rods (under floor).
56 Rudder push-pull rods.
57 Elevator push-pull rod.
58 Rudder sealed balance.
59 Rudder pedals with toe brakes.
60 Pitch and power push-pull rods.
61 Trim and control lock cables.
62 Flap lowering chain.
63 Flap ram.
64 Flap guide rails.
65 Flap operating cables.
66 Flap and undercarriage emergency lowering air bottles (3,000 lb/sq in).
67 Starboard console, mainly electrics. (Port console removed, autopilot, lights, and Gyrosyn compass controls).
68 Trim tab.
69 Balance tab.

Radio and electrics

70 No. 1 inverter.
71 Stand-by inverter.
72 Inverter change-over panel.
73 24 volt 25 amp accumulator.
74 Battery relays.
75 Ground supply socket.
76 Main fuse panel.
77 Generator circuit breaker panel.
78 Standby battery and fuses.
79 Nacelle electric cable runs and access panel to leading edge.
80 Fuselage cable run.
81 Dual-purpose taxi/landing lamps.
82 C.I.3 compass detector.


11FT. DIAMETER D.H. AIRSCREWS
RADIO RACKS H.F. V.H.F. A.D.F. I.L.S. AND RADIO ALTIMETER
MOVABLE FREIGHT BULKHEAD
CREW ENTRY AND FORWARD FREIGHT DOOR
FORWARD PRESSURE BULKHEAD

83 H.F. aerial mast.
84 V.H.F. suppressed aerial. (Aerials under floor and not shown: A.D.F. loops, A.D.F. sense, I.L.S. glide-path, I.L.S. marker and radio altimeter).

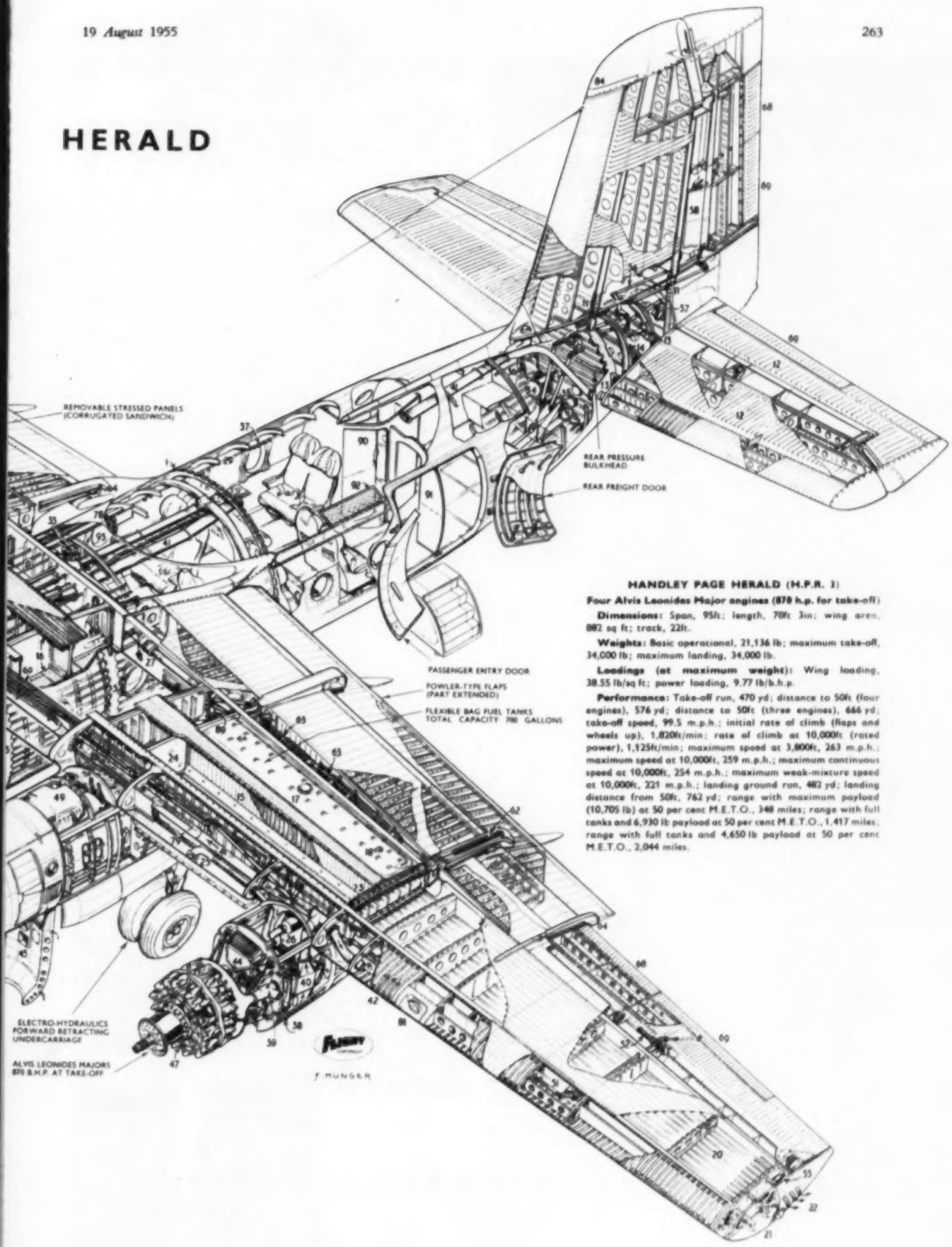
Undercarriage

85 Twin nose wheels (steerable 110°).
86 Door linkage.
87 Hydraulic tank (3,000 lb/sq in system).
88 Brake relay.
89 Top pick-up, undercarriage sub frame.

Accommodation

90 Toilet (removable).
91 Rear bulkhead (removable).
92 Hinged hand-luggage racks (run full length).
93 Aft escape door.
94 Forward escape hatch.
95 Tip-up seat and buffet space.

HERALD


REMOVABLE STRESSED PANELS (CORRUGATED SANDWICH)
REAR PRESSURE BULKHEAD
REAR FREIGHT DOOR
PASSENGER ENTRY DOOR
FOWLER-TYPE FLAPS (PART EXTENDED)
FLEXIBLE BAG FUEL TANKS TOTAL CAPACITY 780 GALLONS
ELECTRO-HYDRAULICS FORWARD RETRACTING UNDERCARRIAGE
ALVIS LEONIDES MAJORS 870 B.H.P. AT TAKE-OFF
F. MUNGER

HANDLEY PAGE HERALD (H.P.R. 3)

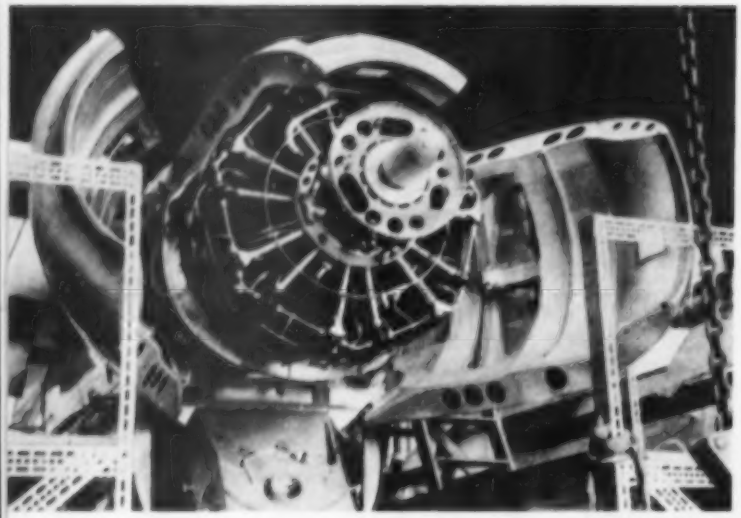
Four Alvis Leonides Major engines (870 h.p. for take-off)

Dimensions: Span, 95ft; length, 70ft 3in; wing area, 882 sq ft; track, 22ft.

Weights: Basic operational, 21,136 lb; maximum take-off, 34,000 lb; maximum landing, 34,000 lb.

Loadings (at maximum weight): Wing loading, 38.55 lb/sq ft; power loading, 9.77 lb/b.h.p.

Performance: Take-off run, 470 yd; distance to 50ft (four engines), 576 yd; distance to 50ft (three engines), 666 yd; take-off speed, 99.5 m.p.h.; initial rate of climb (flaps and wheels up), 1,820ft/min; rate of climb at 10,000ft (rated power), 1,125ft/min; maximum speed at 3,800ft, 263 m.p.h.; maximum speed at 10,000ft, 259 m.p.h.; maximum continuous speed at 10,000ft, 254 m.p.h.; maximum weak-mixture speed at 10,000ft, 221 m.p.h.; landing ground run, 482 yd; landing distance from 50ft, 762 yd; range with maximum payload (10,705 lb) at 50 per cent M.E.T.O., 348 miles; range with full tanks and 6,930 lb payload at 50 per cent M.E.T.O., 1,417 miles; range with full tanks and 4,650 lb payload at 50 per cent M.E.T.O., 2,044 miles.



"Flight" photograph

The Alvis Leonides Majors have petal cowlings. The lowest panel hinges from the firewall, the others from behind it. As a type, this two-row Leonides first ran in July 1953

HANDLEY PAGE HERALD . . .

cowlings when the latter are closed. The oil-cooler air scoop is integral with the top petal and the engine air intake is integral with the bottom petal, forming a flute on its outer skin. A ram entry for cold air is provided by a longitudinal flute integral with the cowling and an ice guard is fitted at the forward end. A hot-air entry to the intake, taking air from around the engine, is provided inside the petal. A "sheltered" louvre entry just behind the intake has a Vokes dry filter above it and is controlled by electrically actuated shutters. Exhausts are on the outboard side of each nacelle, and on the outer nacelles only the exhaust gases pass through two heat exchangers, behind the fireproof bulkhead, which provide warm air for the cabin and for aerofoil anti-icing when this system is fitted.

Engines are easily removed. After the generator has been taken off it is necessary to disconnect electrical cables to magnetoes, starter and thermocouples, the control rods, oil and fuel connections, fire extinguisher and, on the outboard engines only, the blower. All that is then necessary is the removal of five bolts securing the engine mounting ring to the engine mounting. During removal the cowling petals remain in position, hinged back and secured by their stays.

Dual flying controls are fitted. The cranked control columns are pivoted on bearings under the cockpit floor and carry ram's-horn handwheels. Rotary movement of each handwheel is transmitted to a sprocket, movement of which is transmitted to the ailerons by a push/pull rod system. Fore-and-aft movement of the column is transmitted to the elevators by a system of cables and tension rods passing beneath the floor. Toe-operated hydraulic brake controls are connected to the rudder-pedal assemblies.

The fuel system meets the civil airworthiness requirements of Great Britain and the U.S.A. There are four flexible wing tanks, two between the inner and outer engines on each side of the fuselage. Each tank holds 175 gallons, giving a total capacity of 700 gallons. There is space for two auxiliary tanks, each holding 75 gallons, to be fitted at the root of each outer wing. Each engine is fed from its own tank, but a cross-feed system, controlled by fuel cocks, enables each tank to supply any engine or group of engines. In addition to the cross-feed between tanks and engines on each side of the aircraft there is a gallery pipe providing cross-feed between port and starboard fuel systems. There are, in fact, eight electrically operated fuel cocks in the system, four for normal feed and four for cross feed. Engine priming is by two electrically operated pumps, one in each inboard nacelle. Each serves both engines on its own side of the aircraft. In both inboard nacelles are two sumps, each containing two submerged fuel pumps, one "in use" and one "standby." Each pump-assembly incorporates an isolating tank, which allows the pump to be removed without draining the fuel tanks.

The 3,000 lb/sq in hydraulic system operates the undercarriage, flaps, nosewheel steering and self-centring, and wheel brakes. There are two engine-driven pumps, one on each side of the starboard engines, drawing fluid from a common reservoir and passing it, *via* non-return valves, to a cut-out valve. A remote-reading gauge registers the supply-system pressure. A small accumulator ensures efficient operation of the cut-out valve and there are self-sealing ground-test connections in the main suction and delivery lines, permitting ground testing of the complete system. Should the hydraulic system fail, the undercarriage and flaps can be lowered by ground-charged air bottles, which store sufficient energy for one lowering of the components. The air is led to a "third volume" chamber in the undercarriage and flap jacks and the corresponding lock jacks, and does not mix with the hydraulic fluid, so that bleeding of the system after emergency operation is unnecessary. An emergency accumulator stores energy sufficient for six full brake-applications. Fluid is delivered direct to the brake units, via shuttle valves, but without differential control.

The cabin air system maintains a pressure differential of 3.35 lb/sq in and will, in a fully furnished and part-insulated aircraft, maintain an internal temperature between 15 deg C. and 21 deg C. under suitable cruising conditions above 10,000ft, with the outside temperature varying from inter-continental maximum to minus 30 deg C. It provides more than 50 lb of fresh air per minute at 15,000ft. Ram air enters through an intake on each side of the centre-section and passes through Vokes filters to two Godfrey blowers, each driven by an outboard engine. From the blowers the air is transferred to air-to-air heat exchangers, one in each outboard nacelle, where it is cooled by ram air from an intake in the nacelle itself. From the heat exchangers the air passes through lagged, lightweight ducting, running behind the main wing-box to the fuselage, where it is ducted forwards and rearwards along the roof above the ceiling panels. Supply is taken to individual entries at the kicking strips and two punkah louvres. A Normalair control unit, on the port console, controls the pressurizing system by means of spill valves and a mixing valve at each heat exchanger. A discharge valve, two inwards pressure-relief valves and a pressure safety-valve are mounted on the rear pressure bulkhead. A further safety valve with a pilot-operated control is fitted on the front pressure bulkhead. After circulating, the air is taken downwards between the fuselage skin and the furnishings to beneath the floor, where it is ducted to the front and rear bulkheads.

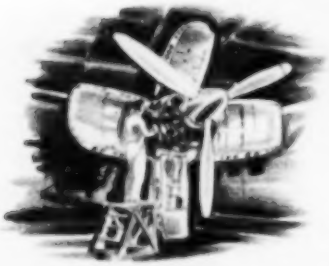
Reference has already been made to the provision for hot-air anti-icing. To meet the requirements of less severe, or occasional, icing, a mechanical overshoe system can be fitted. The airscrews can have an electrical system, and the windscreen either an electrical or fluid system.

An automatic electrical system gives warning of fire in the power plants. The fire-extinguishing system, fed from electrically operated methyl-bromide containers, is under push-button control by the pilot. Inertia switches come into play in the event of a crash landing. In each nacelle, behind the fireproof bulkhead, are two containers, one a 12 lb exchanger feeding through spray-rings round the engine, and the other a 1 lb exchanger discharging through a pipe into the supercharger casing.

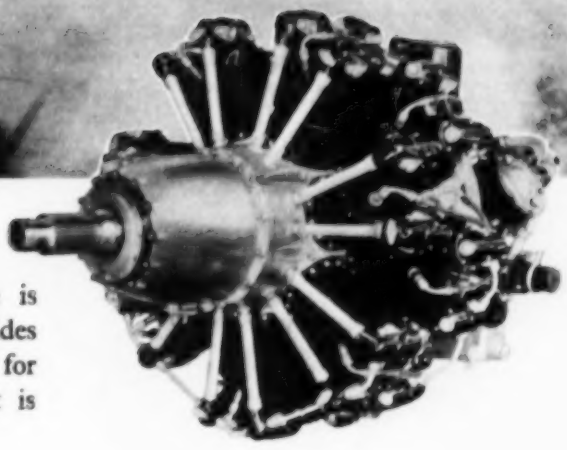
Three 6kW generators supply the services of the 24-volt electrical system through a single-pole earth-return wiring system. There is a storage battery in the supply circuit. The generator system employs three 28-volt 6kW D.C. generators with a 24-volt 25 amp hour battery. The equipment is grouped in the nacelles and the forward portion of the fuselage, with the exception of the emergency battery and such items as instrument transmitters and actuators, which are as near as possible to the items with which they are associated. The emergency battery, of 5 amp. hour

"Flight" photograph

Like the main undercarriage, the nosewheel leg retracts forward and is of Electro-Hydraulics manufacture. Wheels, tyres and brakes are of Goodyear manufacture.



Flight Testing the Major



A very intensive flight test programme is now being carried out on the Leonides Major Marathon to prepare the Major for the many important roles for which it is already scheduled.

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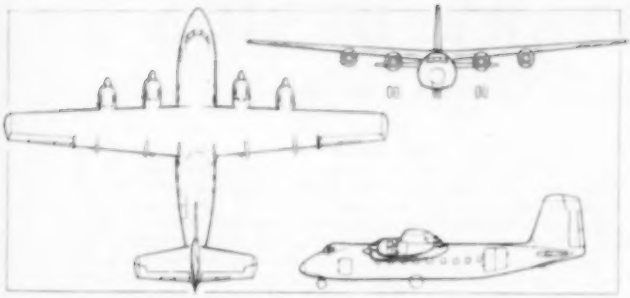


HANDLEY PAGE HERALD . . .

capacity, is in the fuselage roof, near the mainplane shoulder; it supplies the emergency and fire-warning lamps, and the fire extinguishers and the inertia switches. Cables are grouped in looms which run along the fuselage roof and the leading edge of the wing in ducts. All circuits are clearly identified by a code of letters and numbers which indicates the positions of any one cable. Breaks in cable runs have been kept to the minimum, and connection joints, such as terminal blocks and plug and socket joints, are positioned where they will be protected from damage, moisture and oil. Two inverters in the nosewheel bay provide 115-volt 400 cycles, A.C. current for the radio system and for some of the instruments. A standby inverter is provided.

Radio includes communication, navigation and approach-aid equipment. The sets are contained in racks suspended in three tiers from the roof of the forward freight compartment, and embodying anti-vibration mountings, to which the trays are attached. Controls are in the roof of the crew compartments, and the radio fuse and circuit breaker panel is on the bulkhead behind the second pilot. The 19-volt supply for the radio services is maintained by a voltage regulator carried in the roof racks; a spare regulator is also carried. The 115-volt supply is taken from the inverters, and the 24-volt supply from the normal aircraft supply. Of three inverters in the right-hand side of the nosewheel bay, two are in use at a time, the other being a standby. Failure of an inverter is automatically indicated in the cockpit so that the standby can be brought into operation by manual switching. The aerials (except HF) are of the suppressed type. The VHF aerial is incorporated in the fin; the ILS glide path aerial and marker aerial are under the front of the fuselage, with the localizer aerials at the sides of the front fuselage; and the radio altimeter transmitting and receiving aerials are under the fuselage, with the transmitting unit nearby. Communication systems considered suitable for the Herald are Standard Telephones STR.12D VHF (twin sets can be fitted if required); STR.18C HF; or Marconi AD.107.A/114 HF. Suitable navigation equipment is AD.7092D ADF (twin sets if required); STR.30 radio altimeter; DME; ILS; and Sperry ZLI Zero Reader. Intercommunication is by Ultra.

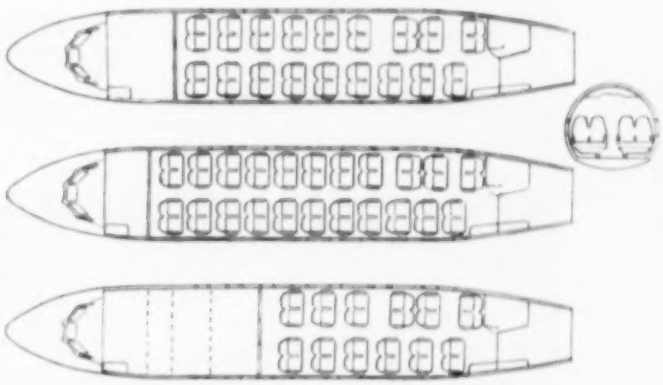
The quickly detachable cabin seats allow rapid conversion for any of the Herald's three roles (airliner, freighter, or airliner/freighter) to another. The seats themselves are of low weight and capable of withstanding 9g fore and aft loads. Attachment sockets allow them to be mounted facing either forward or aft on each side of a central gangway, and they can be spaced at 38in or 33½in pitch. In the former case 36 passengers can be accommodated; in the latter, 44 passengers. Each seat is mounted at three points. Two lateral tubes, forming the base of the seat, push into two sockets in a longitudinal member on the cabin wall, and a single vertical leg beside the gangway is keyed to a socket in the floor and secured by a retaining plate and quick-release pin.

The bulkheads, which form the front and rear of the passenger cabin and the wall of the toilet compartment, are attached to the fuselage frames by spring-loaded bolts and spigots. These enable the bulkheads to be removed easily from the aircraft when it is to be converted into a freighter. Alternatively, the front freight compartment can be enlarged by moving the forward bulkhead back to one of the several positions.

As a freighter only, the Herald's total volume of freight space is 1,575 cu ft with gangways clear. As an airliner with a seating capacity of 44, a cabin floor area of 220 sq ft is available. The bulkheads, in this arrangement, divide the fuselage to give 90.5 cu ft of space forward of the cabin. The rear freight capacity of 171 cu ft is constant for all passenger layouts. Passengers can sit where they wish in the cabin provided that the first 650 lb of freight is placed in the rear hold and remaining freight added in the ratio of 2 lb in the rear hold to every 1 lb in the front hold. With this arrangement the c.g. remains within the proper limits, irrespective of where passengers sit. As a combined airliner/freighter with a seating capacity of 36, the floor area of the cabin is 204 sq ft; the bulkheads, in this instance, give a forward freight space of 183.5 cu ft. When 24 passengers and freight are carried, the floor area of the cabin is 166.8 sq ft. Forward freight hold capacity is 469.5 cu ft. Lashing points can be inserted into the seat-mounting key-holes in the floor and to the seat-attachment sockets at the sides of the cabin. The supports for the folding luggage-racks incorporate lashing points, which can be used when the luggage racks are removed.

Control and instrument arrangement is such that the Herald can be operated normally with a flight crew of two or—for ferrying purposes—with only one. A radio operator's station can be provided, if needed. Full dual flying controls are standard, but the layout subsequently described (based on B.O.A.C. and B.E.A. requirements) can be varied.

The pilot-aid and anti-icing installations, together with their controls and instruments, are fitted to operators' requirements. The radio and navigational controls will vary also according to the systems needed by individual operators. A central console carries the main engine controls, trimming controls and selectors for the undercarriage, flaps and pilot-aid systems. Consoles on the left and right-hand sides of the cockpit carry duplicated jack-boxes and control boxes for the intercommunication and radio



Alternative arrangements for 36 seats (top), 44 (centre) and a passenger-and-freight load; the dotted lines indicate alternative bulkhead positions. Note fuselage cross-section in the inset view.

circuits. The left-hand console, in addition, carries the cabin pressurization controls, the master pilot-aid control and a sensitivity switch for the ILS. Generator field circuit breakers and regulator trimmers, the A.C. fuse panel and a compressor gauge for the pilot-aid are on the right-hand console.

Engine instruments, cabin-pressurization and temperature indicators and Zero Reader controls are at the centre of the main panel. The left and right-hand sides of this panel carry the undercarriage and flap position indicators, duplicated blind-flying instruments and pressure gauges for the hydraulic and pneumatic systems. Emergency controls and indicators for the power plants (feathering, fire-warning, etc.), and power-failure warning lamps are on a panel fitted to the coaming above the main instrument panel. Engine-starting and fuel-system controls and the meters for the electrical systems are in the centre of a panel above the windscreen. The right-hand section of this panel carries switches for the majority of electrical services, while anti-icing controls are on the left-hand side. Radio controllers are in the cockpit roof immediately behind the engine-starting and fuel-system control panel.

IMPROVED MOLYBDENUM

CHIEF of the non-ferrous metallurgy division of the Battelle Institute, Columbus, Ohio, Mr. R. I. Jaffee has announced a method of imparting great-r strength to molybdenum for use at temperatures up to 2,000 deg F. The method involves sintering the metal with finely dispersed oxides.

The best of the metallic alloys "lasted 292.7 hr" (presumably to rupture on single loading) at 25,000 lb/sq in at 1,800 deg F. The best composition with oxides, however, which was Mo 0.5—ZrO_2, lasted 600 hr under similar conditions. Moreover, the stress to fracture had to be increased to 40,000 lb/sq in during the first 500 hours. The rupture strength of molybdenum at 1,800 deg F can be increased three- to four-fold, without adversely affecting hot workability or room-temperature ductility.

DOUGLAS MILITARY DESIGN

Ed. Heinemann Discusses the Technique Underlying His Aircraft

THE thinking behind the latest series of Douglas aircraft for the U.S. Navy and Air Force was discussed by Ed. Heinemann, chief engineer of the Douglas El Segundo Division, in a paper read to the recent Fifth International Aeronautical Conference in Los Angeles. His remarks were confined (if one can use the term in connection with so prolific a designer) to the series of military aircraft for which he has been responsible since the war, namely the AD Skyraider, A2D Skyshark, F3D Skyknight, A3D Skywarrior, A4D Skyhawk and F4D Skyray, the last-named of which holds the present world's speed record over the three-kilometre course at 752 m.p.h.

Mr. Heinemann began by discussing trends in performance. The speed of aircraft, he said, had increased by an average of 13.6 kt each year. With further increases the problem of heating, not serious yet, would arise; and the attainment of really high altitudes would also necessitate really high speeds. He showed the regions of speed (Fig. 1) in which various types of powerplant could broadly be said to operate. The ramjet was excluded, since it was not independent of assistance at low speeds. The borders of the envelopes were not hard and fast, but formed a general indication for different airframes of approximately equal lift and drag characteristics. Heat began to influence structure and equipment at about 200 deg F, and the temperatures shown were those eventually achieved when flight was held constant at the speeds indicated.

If the powerplant was suitable, the most important factor governing aircraft speed was drag, and this was the sum of (1) skin-friction, (2) base drag from bluff afterbodies, (3) wave and separation drag and (4) drag due to lift. (1) and (4) were predominant in subsonic flight and (3) in supersonic flight. (3) could best be reduced by the use of low aspect-ratios, sharply swept wings, thin aerofoils, high-fineness-ratio bodies and careful attention to the blending of components. Figs. 2 and 3 showed the drag distribution for an aircraft of the F4D type and the effect of aerodynamic refinements on its performance, measured at 35,000ft. There had been no increase in thrust at the same time. Speed improvements at higher and lower altitudes were slightly less than at this height.

Another aerodynamic problem encountered frequently was buffeting caused by boundary-layer separation through adverse pressure-gradients formed with strong shock-waves. With aerodynamically ideal airframe contours this could be avoided, but it was always necessary to establish a compromise between aerodynamics and operational and structural requirements. Buffeting had occurred at the jet orifice of both A4D and F4D because of the fairly abrupt taper of their fuselages round the early small-diameter outlets. [The photographs below show the type of modification which cured this condition.] The A4D had not previously been able to exceed Mach 0.7 to 0.8 because of buffeting, and the F4D had to have the fin and trimmers stiffened because

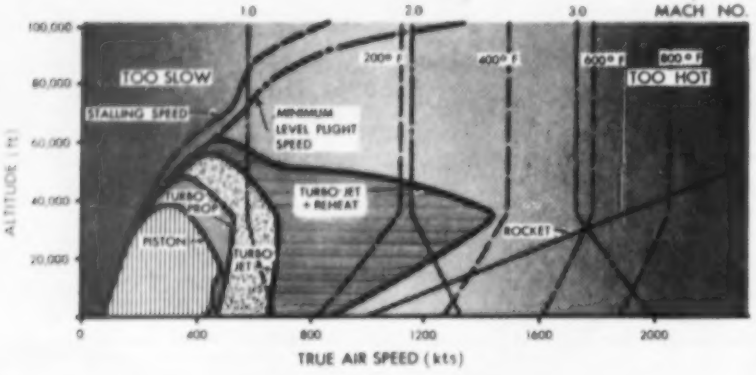


Fig. 1 (left). The typical flight envelopes for aircraft using different powerplants, showing the altitudes and speeds at which they could operate. The airframe temperatures shown are those which would stabilize in continuous flight at those speeds, with 90 per cent recovery and no radiation losses.

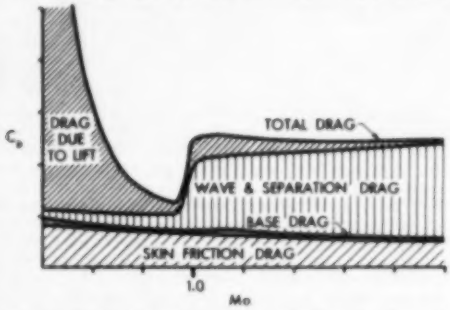
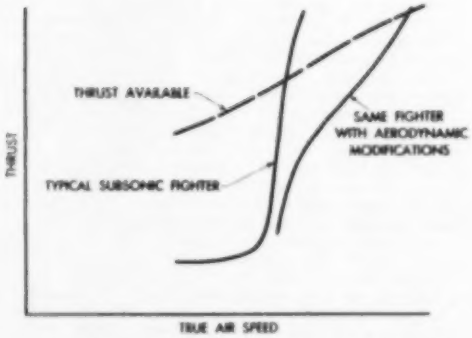
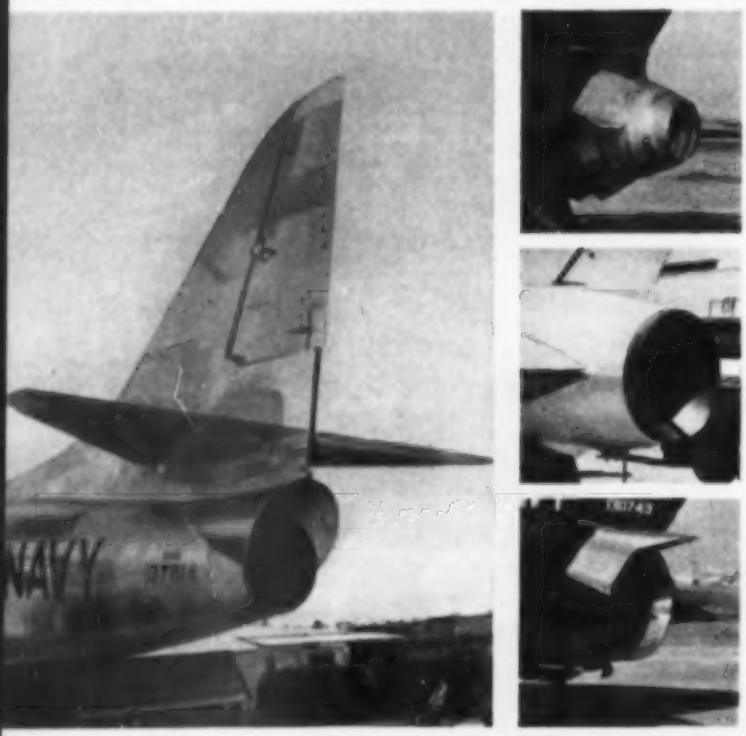


Fig. 2 (above). The composition of total drag at 35,000ft for various speeds.

Fig. 3 (below). Aircraft speed at 35,000ft plotted against thrust available, showing improvements obtained by airframe refinements.





(Left) The modifications of the tail pipe of the F4D Skyray illustrate the steps taken to raise the buffet boundary of this aircraft. The oversize orifice which resulted led to a 10 kt reduction in cruising speed, but a 40 kt increase in buffet margin. Similar factors led to the modification of the A4D Skyhawk's tail as shown at far left.

the buffet remaining after modifications caused them to vibrate at their natural frequencies. The tail orifice of the F4D was made oversize for the jet-pipe. This had caused a 10 kt reduction in cruising speed, but had raised the buffet limit by 40 kt.

The most critical case had been the A3D Skywarrior, where the wing/nacelle pylon had raised local airflow-speeds of Mach 1.25 at an aircraft speed of Mach 0.8. This had been cured by extending and cambering the pylon. Broadly, when external lines were sufficiently refined for supersonic flight, transonic separation tended to disappear.

Buffeting at lift coefficients encountered during high-altitude manœuvring was another problem. The F4D-1, at "Mach 1.0 plus 2 or 3 tenths," in a turn, developed some buffeting, but the effect was never so intense as to become a limiting consideration. The A4D, on the other hand, suffered severe buffeting accompanied by random wing-dropping; but this could be minimized by the same remedies as those which raised the buffeting boundary. This had been done in the case of the A4D by the addition of turbulators, and though these were strictly "aerodynamic crutches," the ease with which they could be applied made them attractive.

Mr. Heinemann then turned to "pitch-up," or longitudinal instability near the stall, which could occur both in high-speed manœuvres and in the landing configuration. Almost all aircraft carried some means of reducing pitch-up, unless a limit was applied to the angle of attack or lift coefficient through the control-system or by operational restrictions. The easiest pitch-up remedy was the slat which, despite its weight and comparative complexity, was automatic and caused no adverse effects while opening or closing. Fig. 4 was shown to demonstrate the improvements obtained by the use of slats, leading-edge camber and wing fences on the A3D Skywarrior, although these had not been achieved easily. A better remedy would have been to lower the tailplane,

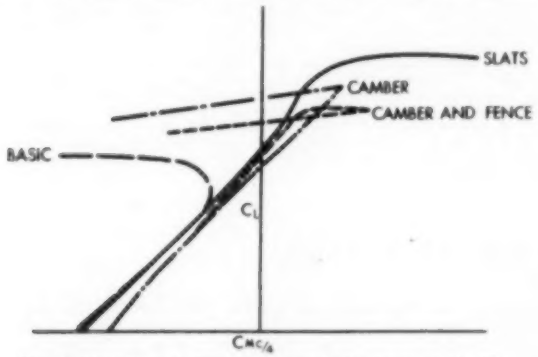


Fig. 4. The effect of slats, camber and wing-fence on the lift coefficient in the landing configuration of the A3D Skywarrior carrier-borne bomber.

but this could not be done on account of the engine exhaust-gas cone. The A4D was stable without slats, but they had been added because of the great increase they allowed in maximum lift coefficient. The F4D was more stable longitudinally without slats, but it carried them to improve lateral control at low speeds. Mr. Heinemann said that further research was required to allow the elimination of slats with their attendant structural complication.

On aero-elastic effects, the speaker said that structures should be designed to allow for deflections as well as required strength, and that, in the case of the wing, spoiler ailerons could give a powerful additional rolling moment without causing further wing twisting. Rigid-model wind-tunnel tests were completely misleading unless results were corrected for the degree of flexibility expected in the full-size airframe.

In lateral-directional oscillations, or Dutch roll, yaw-stabilizers had been found particularly beneficial both in the A3D and the F4D. In the A4D an all-out, and successful, attempt had been made to avoid the necessity for such a device.

The problem of lateral-longitudinal coupling had recently arisen in flight tests, where rolling caused yawing which exceeded the permissible side-loads on fuselage and tail surfaces. It was to some extent due to the increased fore-and-aft dispersion of concentrated loads in military aircraft, and was predominantly a gyroscopic phenomenon. Five degrees of freedom equations were required to analyse it, in place of previous simpler three degrees of freedom equations.

On longitudinal control Mr. Heinemann stated that whereas the proponents of full-powered controls were rapidly gaining ground, it was necessary to choose the simplest effective arrangement consistent with the aircraft's operational rôle. The A3D and A4D both had a boosted elevator and V.I. tailplane, which had proved simple and adequate. The F4D, requiring high manœuvrability at high speeds, had a complete fully-powered system which, together with a low wing-loading, gave it an advantage over most aircraft in the transonic range. At supersonic speeds a tailplane gave the advantage, but manœuvres initiated at low supersonic speeds mostly decelerated the F4D quickly into the region where the plain delta once again scored.

In connection with engine-intake systems Mr. Heinemann reported much the same difficulties and requirements as were outlined in the summary of Mr. J. S. Alford's paper (*Flight*, July 29th). Boundary-layer sucking or blowing, continued the speaker, had shown definite advantages for landing—though not for take-off, because of the power reduction while bleeding the engine compressor for blowing. Future, though as yet distant, applications would aim at reducing drag during high-speed flight.

Mr. Heinemann next turned his attention to structures and materials. The structures of the Douglas aircraft discussed in the paper were, he said, quite conventional. If wing-folding was required a two-spar wing was the obvious way of accommodating hinge loads, but where no fold was needed, as in the case of the A4D, a multi-spar wing with a 0.064in aluminium alloy skin with extruded z-section stringers was used. This wing also acted as an integral fuel tank. Magnesium was the optimum material for a full-monocoque fuselage, such as that of the Skyrocket, but the susceptibility of the metal to corrosion made it unsuitable for carrier aircraft. The 75ST alloy was most used and was superior to other metals up to 200 deg F. When higher temperatures arose the older 24ST, with copper as the main alloy, would give satisfaction up to 400 deg F.

It was important to remember that at speeds where aerodynamic heating became important, the aircraft might well run out of fuel before the full theoretical heat level had stabilized. Calculated stable airframe temperatures would probably not be reached in practice—because of this thermal inertia—until very-high-speed aircraft had a fairly long endurance.

The most common steel used was 4130, but for greater strength a manganese tool steel, high in silicon, with the trade name Hy-Tuf, was satisfactory. It was in fairly short supply, but would otherwise be used more frequently than just for the undercarriages and arrester hooks of some types. Titanium was used in a few cases, particularly in the breech of a bomb-ejector pylon where steel had not stood up sufficiently to the heat.

Of equipment and arrangement, Mr. Heinemann said that the current "system" approach where the designer had control of the whole project seemed ideal, but considerations of standardization, logistics and availability must be taken into account. The aircraft designer could, moreover, exercise a great influence on the equipment designer, especially if the latter was reminded of the growth factor involved with overweight equipment. The speaker placed this at 10 for the average military aircraft (see table).

INFLUENCE OF EQUIPMENT ON GROSS WEIGHT

	Weight of Original Design (lb)	Weight of Redesign (lb)	Effect on Gross Wt. (Wt. difference x growth factor of 10) (lb)
Seat, ejected weight	70	31	390
Communication equipment	168.3	110.2	581
Bomb rack	65	49	160
Wing fold	200	0	2,000
A.C. v. D.C. electrical	527	318	2,090
Instrument	30	21.5	85
Armour plate	175	0	1,750
Afterburner	750	0	7,500
Oxygen system	64.5	19.6	449
Bomb-bay	500	0	5,000

There was some doubt as to the relative merits of piloted and unpiloted aircraft, especially as to where the second should take over from the first. Each, however, had its particular advantages, but much had to be done to preserve the human pilot's decision-making assets in the face of increasing speeds. Human tolerances were fairly well known, and Mr. Heinemann showed some diagrams, an example of which is shown in Fig. 5. An important

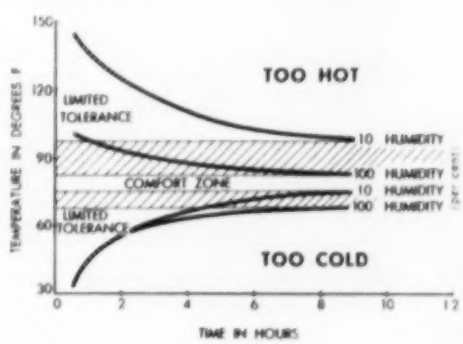


Fig. 5. Humidity and temperature limits for the human body plotted against time.

DOUGLAS MILITARY DESIGN...

morale factor was escape, and here it was considered that the escape-chute or ejector seat were feasible up to from Mach 1.0 at sea level to Mach 2.0 at 45,000ft. At all higher speeds a capsule was necessary. A great deal of work was being done on control-lever arrangement and shaping, harness, seats and other cockpit equipment to ease the pilot's task.

Before ending, the speaker touched on the all-important problem of equipment reliability, which, he said, had been found by U.S.A.F. surveys to decrease at established rates in proportion to the reliability and number of component parts, as shown in Fig. 6.

Mr. Heinemann concluded by saying that his lecture had outlined some of the problems and limitations concerned in the design of some successful military aircraft. The outstanding rule, regardless of the aircraft's purpose, should be "keep it light, simple and reliable." This precept clearly lies behind the speaker's success in designing such widely differing aircraft as the F4D Skyray and A4D Skyhawk.

THE DISCUSSION

Dr. G. V. Lachmann (director of research, Handley-Page, Ltd.), said that it was gratifying to hear Mr. Heinemann praise the slot, particularly as he was renowned for cutting down parasitic weight.

One might ask why there were no slats on the Victor. Such devices had, in fact, been considered when the H.P.80 was projected in 1946-7, but, in view of the thickness/chord ratio of the outer wings—no more than 4½ to 5 per cent—it was then found difficult to install them in the profile. He asked Mr. Heinemann what was the minimum wing thickness for slat installation. Their own solution, nose flaps, were adequate aerodynamically and rather lighter, structurally, than slats; but the hydraulic system—particularly that required for "instantaneous" operation had no mean weight, whereas slats could be made to work themselves.

He was surprised at Mr. Heinemann's flight envelope showing the upper limit of turbojet operation as 600 kt (with an afterburner required at higher speeds); perhaps through a different philosophy, Britain believed that the basic turbojet limits were much higher. As regards yaw dampers, Victor experience certainly confirmed Mr. Heinemann's conclusions regarding their great usefulness. Boundary-layer control methods, by blowing or sucking, were controversial. A single blowing-slot was effective but the engine power was otherwise required at take-off. At Handley-Page they had great hopes of schemes based on attaching the flow by suction.

Mr. Heinemann, replying, confirmed that his thinnest wings were of 4½ to 5 per cent t/c ratio, and that slats had been quite readily installed.

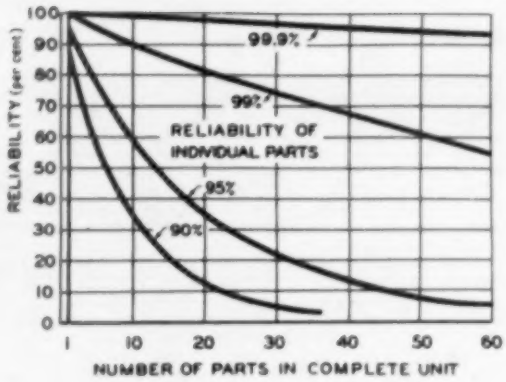


Fig. 6. U.S.A.F. surveys in the field have shown these reliability factors in equipment composed of varying numbers of components, each of a known individual reliability.

His engine performance curves had been based on the most optimistic data obtained from engine manufacturers.

Mr. Woods (aeroplane design consultant, Bell Aircraft Corpn.) noted that firms with actual supersonic flight experience approached high-speed design problems with more caution than did other companies. Guided-missile experience had preceded, and to a limited extent had formed a guide for, supersonic manned-aircraft design, but the missile required no subsonic characteristics and did not have to perform as an armament platform. Only full-scale flight-testing, of subsonic, transonic and supersonic behaviour, could provide a sure guide to the correct wing configurations required.

Mr. R. G. Fowler (chief aerodynamicist, Folland Aircraft) commented on the absence of remarks by Mr. Heinemann on wing loading. He also inquired whether or not the Douglas yaw-dampers were of the simple viscous (as distinct from the electrical) type.

Mr. Heinemann, replying, said that the requirements of carrier operation imposed definite restrictions on the order of wing loading which could be accepted. A low wing-loading gave a double advantage in permitting greater manœuvrability and a higher ceiling. The maximum lift-coefficient of the bat-winged F4D was actually roughly half that of the A3D Skywarrior, and it could be deduced that the latter machine had, in consequence, roughly twice the wing loading of the fighter.

BUILDING THE R.A.E. TEST TANK

PHOTOGRAPHS of the Bristol Britannia "specimen" undergoing its water test in the new Farnborough tank have already appeared in *Flight* (page 750, June 3rd and page 820, June 17th), and it is now possible to add some notes on the construction of the tank itself. The information has been provided by Horseley Bridge and Thos. Piggott, Ltd., of Tipton, Staffs, who were responsible for its manufacture.

Briefly, the tank may be described as consisting of three separate parts: (a) the forward end, constructed from standard 4ft tank plates and half-plates, with a top tier of specially pressed plates; (b) the wing box—a mild-steel section to accommodate the water seals affixed to the base of the wings; and (c) the rear end, again constructed from standard plates, half-plates and special pressings. The entire floor consists of standard plates and carries rails to take the aircraft on bogies.

Overall dimensions of the tank are 160ft long × 20ft wide × 20ft high. For any normal water-storage application, a tank of comparable size (but which in any case would be unlikely to exceed 16ft in height) would have internal stays to brace the walls against the outward pressure. The very nature of the test purpose, however, demanded that the test tank should have an interior completely free of obstruction. This requirement was met by the fitting of external frames consisting of 9in × 7in rolled-steel joists for the base and 18in × 6in R.S.J.s for the verticals, with top ties, at 4ft centres throughout the length of both pressed-steel-plate sections.

The sides of the lower half of the wing box were constructed from mild-steel plate 84in wide by ½in thick, butt-welded to a continuous web carrying horizontal stiffeners and reinforced with internal vertical stiffeners of 10in × 4½in split "I" section, welded to the web. There is also external staying.

Surmounting the wing-box diaphragm plates on each side of the tank are heavy welded plate girders in the form of an inverted "T," constructed from ½in plate. The base member, designed to counteract horizontal water pressure, is reinforced longitudinally with 6in × 3in billets, increased to 5in thick above the wing apertures. The vertical section, strengthened by internal and external web stiffeners, carries the dead weight of this base.

In order to support this weight and to maintain it against the extremely high internal pressure, end frames were incorporated, built up from fabricated box girders. The verticals, suitably stiffened, were made to a special shape, proportionately increasing in breadth from 2ft at the top and bottom to 3ft 2in at the point of greatest stress, ten feet above the junction with the base member. Eight 2in diam. H.T. steel dowels resist any tendency to twisting under stress.

In addition to undergoing the normal loading tests, special cross-members above the tank were also subjected to fatigue loading tests, since they carry some of the equipment necessary to create fatigue stresses in the aircraft on test and thus come under similar stresses themselves.

A photograph of the tank during initial erection at the makers' works appears on p. 271.

EXHAUST AUGMENTERS FOR DOVES

THE American agents for de Havilland Doves, Butler Airplane Sales of Dallas, Texas, are offering exhaust augmenter installations for standard Doves. The system was developed jointly by this company and Dallas Aero Service, who tested six different aircraft with various refinements aimed at increasing the cruising speed. The best of those tried proved to be the exhaust augmenter, which (it is stated) for a cost of $2,780 (about £990), adds between 8 m.p.h. and 16 m.p.h. to the Dove's cruising speed, raising it above the 200 m.p.h. mark.

The principal effect of the augmenter is to smooth out the airflow around the standard exhaust stacks, close to the wing leading edge, but it is also said to lower by half the back-pressure in the cylinders, and to save some ten pounds of weight. The modification is claimed to be worth some three to four inches of manifold pressure at 8,000ft.

At present the augmenters are being offered to potential customers on a trial basis, one pipe only being fitted, and removed again free of charge should no increase in cruising speed be noticed. Test climbs, carried out with 42in boost and 2,700 r.p.m. at 105 m.p.h., showed that the augmenters gave better cooling in these conditions than the original stacks.

Augmenters are fitted as standard equipment to most of the American light-twin executive aircraft.

Design starts from an attitude of mind

The real starting point of aircraft design at ENGLISH ELECTRIC is not a piece of drawing paper but an attitude of mind.

There was a time when admirable aeroplanes were designed by drawing (and re-drawing) until their nicely flowing curves were good to look at. This simple philosophy lasted surprisingly long, but it had unhappy side-effects. It inspired some unthinking people to believe that the intuition of an artist was a satisfactory substitute for the enquiring mind of the scientist. What worked—generally, but not always—in the low-subsonic piston age doesn't work today. Today there is *no* substitute for knowledge. Today the tools of the design team are the same as the tools of the scientist—analogue computors, supersonic wind-tunnels, electronic laboratory gear, harmonic analysers, cathode ray oscilloscopes and the kitchen stove and refrigerator (in larger and more highly-developed forms). But even then what finally matters is the team's attitude of mind towards its tools.

Our attitude at ENGLISH ELECTRIC is one of open-minded enquiry into what is a dauntingly big and complex problem. There are no tools we will not use—even if we have to invent them first—to find out all we have to find out; and there is no substitute for finding out. Before ever a new aeroplane flies, it must have been 'flown' on the ground until nothing that is knowable without test flying is left unknown.

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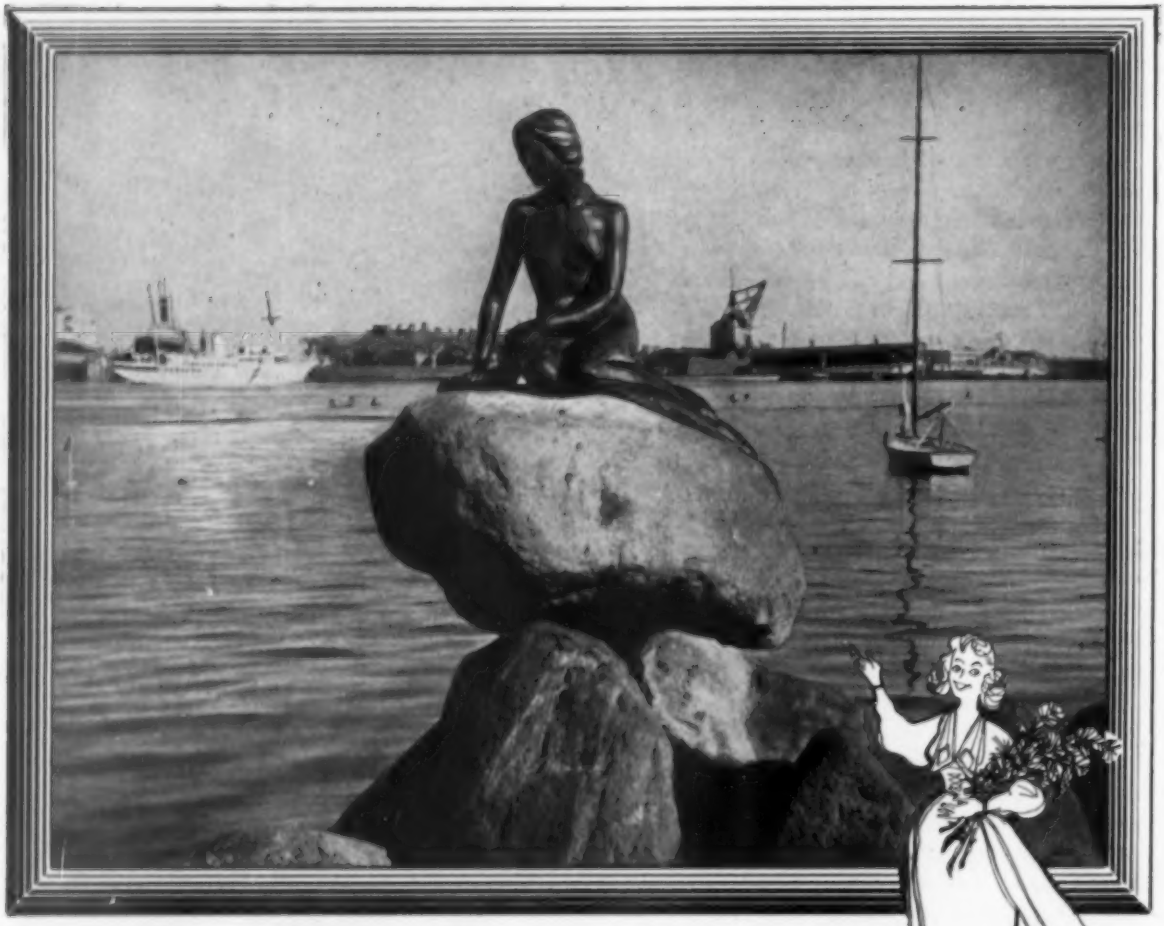

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BRITISH EUROPEAN AIRWAYS

R.A.F. MODEL CHAMPIONS

COMPETITORS to the number of nearly 200, representing all R.A.F. commands in the United Kingdom, converged on R.A.F. Station Horsham St. Faith for the recent annual two-day championship meeting of the Royal Air Force Model Aircraft Association.

Promptly at 0900 hr on the first day, the contest director, F/L. A. Coutts-Smith, gave a briefing from which it was apparent that much detailed preparation and organization had taken place for the benefit and enjoyment of the competitors. Although the previously prevailing hot summery weather was conspicuous by its absence, the day remained fine and overcast, with a 15-20 kt wind which proved annoying to the majority of competitors.

From an inspection of the *concours* models it was seen that the high standard of entry was being maintained. Particular interest was aroused by the beautifully finished solid scale model of a Watanabe J.7 W1 Shindin, with retractable undercarriage and sliding cockpit canopy. In the control-line *concours* section, the blue twin-engined Invader of Cpl. Godfrey of Fighter Command was complete with starter motor and battery box to match. Powered by two 5 c.c. Frog engines, it flies at 80 m.p.h.

In spite of promising met. forecasts, the second day was spoiled by a viciously gusting wind. This was particularly unkind to the scale free-flight and unorthodox models. In the morning some fine maximum and out-of-sight flights were accomplished by the rubber-driven duration models.

Considering the conditions, some good flights were achieved in the scale free-flight event. Jnr. Tech. Percival's See-gull and F/O. Norman's Seabee managed to cope, while the Super Swede of Sgt. McHard accomplished a splendid flight of just over 60 sec, unfortunately ending in a distant tree. F/L. Coutts-Smith's Luscombe 8a also managed a meritorious 44 sec. The diminutive Dart Pup of Cpl. Tech. Abbey clocked 41 sec of exceptionally stable flight in such conditions.

The C-in-C. Fighter Command, Air Marshal Sir Dermot A. Boyle (president of the Association) arrived during the morning, accompanied by Lady Boyle, who afterwards presented the prizes; and other interested spectators included a former president of the Association, Air Chief Marshal Sir Hugh P. Lloyd, A. Cdre. Worrall, G/C. Aitken (O.C. Horsham St. Faith), G/C. Saw and Mr. Houlberg (president) of the S.M.A.E.).

(Top, left) Cpl. Merry of Flying Training Command with a model of Fillons Champion glider, fitted with radio control. He came third in the glider concours and third in the open glider duration competition.

(Top, right) F/O. Norman releasing his scale Seabee in the scale free flight event for the R.A.F. St. Athan Trophy. This model has a retractable undercarriage, fully detailed cockpit and operable flaps.

(Right) Sgt. McHard of Wellesbourne Mountford with his "Super Swede" canard delta, powered by a Frog diesel engine. It won the "unorthodox" event with a flight of 65 sec.

During the afternoon, between showers and in conditions which could only be described as downright disheartening, radio-control competitors did their best to beat the wind. Although F/L. Cable nearly succeeded, the wind won easily against all except Cpl. Brooker, the eventual winner. His model was a pusher, and with its high thrust-line just held its own against the elements.

Placings.—(1) Fighter Command, 161 pts; (2) Technical Training Command, 106; (3) Flying Training Command, 98; (4) Coastal Command, 85; (5) Bomber Command, 65; (6) Transport Command, 59; (7) Maintenance Command, 33; (8) Home Command, 20; (9) 90 Group, 17.

MAN IN SPACE

RECENT announcements in several countries of new national investigations into space-flight phenomena lend interest to this brief review. A report by the author, Mr. John Brown, on the high-altitude research being pursued in a number of different parts of the world was published last month by UNESCO.

WHEN I asked Colonel Paul A. Campbell, former chief of space-medicine experiments in the United States Air Force, if there would be an upper age limit for travellers in space rockets, he said "No—the problem is to create a suitable environment." During the first experiments at Peenemunde in Germany and at Fort Knox and Pensacola in the United States efforts were made to test individuals for g-tolerance and general adaptation to high-altitude work. It was found that there were wide variations between individuals, and the experiments were inconclusive; so today's research is concentrated on the vehicle and the maintenance of an artificial environment that will maintain earth conditions in outer space.

Accelerations of up to 10g were tolerated by untrained individuals without g-suit protection if they were in a semi-prone or prone position. This position is necessary in order that a line representing the angle of acceleration shall bisect at right angles a line drawn between the two semi-circular canal systems of the inner ear. This precaution is essential to avoid disabling vertigo.

At 10g men can talk in monosyllables, retain clear vision and mental alertness, respond to signals, and have fair if not full mobility and dexterity of their limbs.

Vision is the great problem. Two pilots have been in a gravity-free state for periods of nearly 30 sec, and although they reported unusual sensations they were not disabled. The inner-ear system of balance is gravity-oriented, but vision can act independently of gravity, and there is evidence of extremely rapid adaptation to unusual conditions if visual clues are present.

My own experiences in hot deserts and at great altitudes on the earth's surface make me confident that the limits of human adaptation to high and low temperatures are not fully realized by the layman. I believe that with minimal air movement and at rest, or with no more than light activity, temperatures of more than 200 deg F can be withstood for short periods; at the Poles explorers have already withstood temperatures of as low as −80 deg F, wearing a Polar assembly of 25 lb of clothing.

In practice, at seven miles above the earth temperature remains fairly constant at about −67 deg F until about 20 miles up. At 31 miles temperature has risen considerably, to approximately 170 deg F. It then drops violently to −27 deg Fahrenheit at 50 miles up. At this level the atmosphere is so rarified that heat cannot be transferred to it, and everything now depends on the reflected or absorbed heat from solar radiation. The sky is always as black as night at 80 miles up, but each new object will become a new light-source, and exposed surfaces should be in their own or the earth's shadow.

The effects of cosmic radiation are now being studied in 16

MAN IN SPACE . . .

countries, at 44 mountain laboratories. That on the Jungfraujoch in Switzerland, at 11,700ft, has been running courses for visiting scientists, and since 1953 there has been a rapid development in international exchange of information. This has included evidence of loss of hair by small animals following heavy-particle hits at high altitude—which might suggest the return of a manned rocket containing a bald as well as bold crew; but the existing evidence is regarded as inconclusive by the scientists.

The essentials for above-atmosphere flight are cabin pressurization, synthetic components of breathing air, and a means of removal for accumulating impurities. The problem of survival in case of accident cannot be solved for some years to come.

Meteor bombardment is another risk, calculated to be 2,000 to 1 (per day) against puncture of a sphere with a diameter of 10ft and with aluminium skin of a thickness of a third of a centimetre.

Some men have shown an astonishing adaptability to gravity changes. Lt-Col. John Stapp of the U.S.A.F. Medical Service has withstood a force of 22g, equivalent in air density terms to a speed of 1,800 m.p.h. at 40,000ft, with the body assuming a weight of nearly two tons. Pronounced facial distortion was observed, but no permanent disability or serious after-effects. Similar experiments have taken place at Farnborough, on the new centrifuge and other devices used to test high-altitude reaction.

Psychological adaptation will, it seems, be more important in crew selection than physical factors. A particular type of man is sought, one who combines intellectual abilities up to a good degree-standard in physics or electronics, with the rarer quality of being a good teamworker. The tough individualist is not wanted. Strangely enough, a tough individualist was the first person to fly in a manned rocket. Or should I say "womanned" rocket? Hanna Reitsch, the woman who waited in vain outside the Reichschancellery bunker on April 30, 1945, to fly Hitler and Goebbels to safety in her Fieseler Storch, with the Russians only a few hundred yards away, flew in a V2 rocket a few months before, and made a safe parachute descent, in an experiment designed by the Dornberger - von Braun team.

This outstanding achievement in aviation history was masked from the peoples of the United Nations by the necessities of war propaganda, just as many of today's experiments are reported two and three years in arrear by the requirements of security. What is certain is that men will soon be trying their luck (if they have not already tried it) in the outer darkness. *Per ardua ad astra* is taking on a new meaning. JOHN BROWN.

ASTRONAUTICS IN COPENHAGEN

THE establishment of American satellites by 1957 and the first attendance of Russian delegates proved to be the highlights of the International Astronautical Congress, which concluded recently in Copenhagen. A number of the papers were amended hurriedly in order to include material which had been declassified by the Washington announcement.

As far as the Russian scientists were concerned they might have indeed been men from Mars; they were surrounded the whole time by a questioning crowd of delegates and reporters. They took it all in good part, and amiably answered nearly all the questions. Professor Ozorovnikov is an astrophysicist from Leningrad while Professor Sedov is an expert on gas dynamics. From their answers to questions it was apparent that Soviet scientists in many fields, as in the West, are at last realizing that space-flight is technically possible and that the tools for important scientific work are currently available by modification of the long-range ballistic weapons.

Word was also received during the Congress that an Anglo-Australian scheme for extreme altitude or satellite research might soon be announced. Astronautics had become respectable almost overnight!

Dr. Kraffte Ehriche of Convair gave plans for a satelloid which is really a powered satellite. The idea is to have a small rocket motor on a satellite vehicle so that it can move in various orbits around the earth. It could, therefore, measure the effects of air drag and skin heating at various levels and determine how manned rockets in the form of supersonic gliders might best approach the earth's atmosphere for a safe landing. Present knowledge of the true extent of the earth's atmosphere is rather scanty; so that, for example, in a paper by N. V. Petersen of New York, several different sets of upper-atmospheric data had to be used to determine the lifetime of a satellite as a function of the orbital radii. Using Grimminger's data, it was shown that a small satellite revolving at the 200-mile level would have a lifetime of only 70 days.

A paper by R. Tousey of the Naval Research Laboratory, Washington, investigated the visibility of the 21in-diameter satellite. Although such a vehicle would be difficult to track by radar, unless fitted with a transponder, it would easily be visible at certain times. The best period for observation would be as the satellite was near to zenith but away from the sun, so that its phase would be greater than half full. The sun should have just set and the satellite could be picked up easily by binoculars, even at 800 miles' altitude. A 200-mile satellite could be seen with the unaided eye as a faint star of about the fifth magnitude one hour after sunset.

Mathematical papers by A. Boni of Italy, D. F. Lawden of Birmingham and J. M. J. Kooy of Holland discussed the techniques for establishing the satellite in the correct circular orbit and the control of earlier stages. The large rocket must be fired vertically but the flight-path in subsequent stages is curved in the earth's field. Two opposite requirements existed for an optimum entry orbit: (1) to reduce air resistance by maintaining low velocities in the dense lower atmosphere and (2) to expend propellants rapidly in order to minimize the need for their transportation to great heights. D. F. Lawden showed that for a large rocket air resistance is negligible compared with the magnitude of the motor thrust, so that the second requirement dominates. The rocket motor must be set to operate at full thrust from the moment of take-off and there is accordingly no involved thrust programme for optimum conditions.

Outlining some problems of rocket development, Capt. G. A. Partel of Italy called for investigation concerning the more energetic fuels such as the metal hydrides. Present military rockets did not necessarily use propellant combinations that would be ideal for research rockets, because choice was governed by many more factors in addition to that of performance. Capt. Partel also discussed the advantages to be gained in reduced air-drag by air launching a satellite. He suggested employing a modern turboprop aircraft for this purpose or, alternatively, choice of a high-altitude launching site. Several of these which had good rail communications were suggested, mainly on the South American continent.

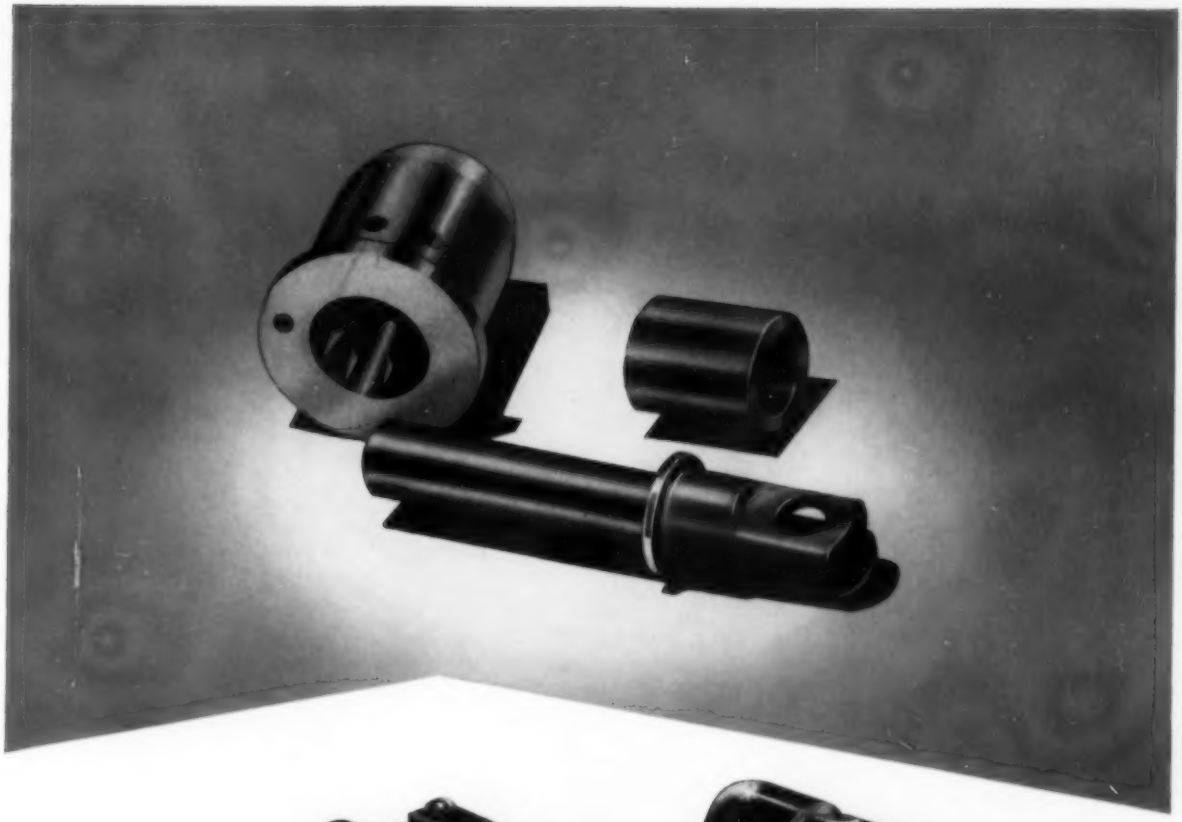
Activities in the International Geophysical Year were discussed by a paper by H. E. Newell of the U.S. Naval Research Laboratory. In addition to the satellite vehicle, American scientists are to launch a large number of small rockets at various points on the surface of the earth, ranging from the Arctic to the Antarctic. The present programme calls for the firing of a total of 45 Aerobee rockets and 120 Rockoons (solid-propellant rockets which are lifted by a high-altitude balloon before being fired; they reach an altitude of 60-70 miles compared with the 80-100 miles of the Aerobee, but they are very much less expensive).

Dangers to crews in manned flight were discussed in detail in a paper from A. Hitchcock of Ohio State University. In the Laboratories of Aviation Physiology there, experiments are being conducted to perfect a pressurized cabin system. Capsule-cockpit design was also referred to by the lecturer.

B. B. Langenecker of Austria explained how energy might be saved in rocket systems by lowering the ignition temperature. Although this would improve combustion efficiency it would result in an increase of combustion temperature, so that better methods of cooling would have to be devised.

It was suggested that the catalyst should be arranged in the form of a system of spirally twisted spokes which would radiate through the head of the combustion chamber from a central hub. The fuel would be injected through pores in the spokes. An alternative method of suspending the catalyst in a mineral-oil fuel was discussed. This research into accelerating effects on combustion processes, and into the use of high-capacity motor walls made of several layers of materials having special qualities, was indicated as being suitable for groups having limited financial means at their disposal.

C. E. Anderson of Copenhagen was of the opinion that corpuscular rays from the sun would be more dangerous than cosmic rays because of their greater flux density. He computed the amount of energy which would have to be absorbed by a spaceship, basing his calculations on the mechanism for producing aurora, and he concluded that this would be dangerously high. Prof. S. F. Singer, of the University of Maryland, was of the opinion that these rays would easily be stopped by the hull of the rocket. He then proceeded to discuss the physical effects of cosmic radiation on matter, both inanimate and biological. There were two separate types of reaction involved: first, there were atomic effects in which the electron shells were modified and which had been investigated extensively, although the biological effects of heavy primaries were still unknown. Secondly, nuclear effects involving fission were small but cumulative. Numerical values



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B.O.A.C. photograph

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ASTRONAUTICS IN COPENHAGEN . . .

for these latter were given for the first time by the lecturer and their biological effectiveness was discussed. The shielding problems against heavy primaries and nuclear disintegrations were very similar, the best shield being such materials as water, kerosine or similar fuels rich in hydrogen. Induced radio-activity on the moon's surface by incoming cosmic-ray particles were considered to be only at a low level which would not be dangerous to crews landing there.

It was decided that the next Congress would be held in Rome, and Mr. F. C. Durrant, of Arthur D. Little, Inc., was elected to continue in office as president of the International Astronautical Federation.

From conversation and private discussion with many of the delegates the impression was gained by this writer that space-flight will be pushed on much more quickly than the most ardent interplanetary might have hoped for a year or so ago. There is an enormous amount of work to be done; but even if governments are still not fully convinced of the technical advantages to be gained by satellites and space-ships they certainly realize now their political importance. ERIC BURGESS.

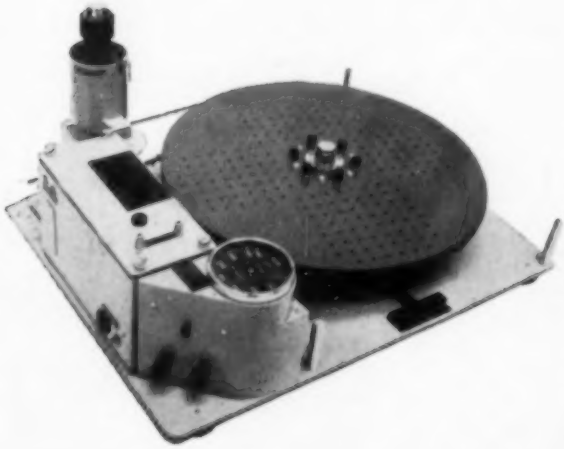
THE INDUSTRY

High-g Component Testing

GUIDED-MISSILE development has called for many new component-testing techniques, and among them are those concerned with quantity testing of assemblies that have to withstand extremely high accelerations.

In response to a Royal Aircraft Establishment requirement for centrifugal test gear which was neither space-consuming nor costly in initial outlay or operation, the firm of Graseby Instruments, Ltd., Hook Rise, Tolworth, Surrey, developed the portable centrifuge illustrated. The apparatus occupies a space of only 32in × 25in, and, including guard, stands less than 16in high. It weighs 170 lb, so needs no special foundation to ensure steadiness in operation.

The Graseby Type GW3 centrifuge.



Giving a range of between 0.25g and 100g, the speed of the table is controlled to within 0.25 per cent by means of a hybrid circuit that has affinities with both Velodyne and Ward-Leonard controls. The circuit ensures a high degree of stabilization in the event of supply-voltage fluctuations.

The table is made of a resin-bonded paper material, the lightness of which reduces the time required to run it up to speed. Up to four components with a total weight of 12 lb can be tested simultaneously, and facilities are provided for making connections to electrically operated and air-operated components.

A number of these Graseby Type GW3 centrifuges, it is stated, are already in use by manufacturers of guided-weapon components.

Lightweight Emergency-battery

IN conjunction with the M.o.S., Nife Batteries, of Redditch, Worcs, have developed an ultra-lightweight, 24-volt alkaline battery for emergency duties in high-speed aircraft. It provides stand-by power for turn-and-slip indicators and cockpit lighting. it weighs under 3 lb and its overall dimensions are 4.25in × 4.25in × 3.375in high.

The new battery, which is now available for civil aircraft and for export, is designed to operate without electrolyte leakage under aerobatic conditions at reduced barometric pressures equivalent to altitudes of up to 60,000ft. Its mechanical strength is stated to be sufficient to withstand loads of 30g in any direction.

The battery consists of 21 nickel-cadmium cells with a nominal capacity of 0.4 Ah. The emergency load amounts to 11W for a minimum of 20 min—5W for the turn-and-slip indicator and 6W for the cockpit lighting.

The Nife alkaline battery and its terminal cover.

Assembled in polystyrene containers, the cells are based on the standard Nife nickel-cadmium design, in which reliability is combined with freedom from self-discharge. The battery, it is claimed, will perform its duties even after long periods of idleness in any climatic conditions from arctic to tropical, with a margin of reserve sufficient to allow a final operating voltage in excess of the stipulated 21 volts.

To ensure high mechanical strength the 21 cells are cemented together in a block (3 cells × 7 cells) and bound with glass-fibre tape impregnated with polyester resin. The terminals are protected by a cover of glass fibre-reinforced polyester resin.

The Nife MP04 cell, measuring 1.33in × 0.57in × 3.1in high and weighing 2 oz, is available for other applications in unit assemblies of up to 24 volts.

The new Farnborough pressure-test tank under initial assembly at the works of its makers, Horseley Bridge and Thos. Piggott, Ltd. Some notes on its construction appear on page 268.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

For the (Early) Record

WHEN preparing the material for my recently published book *Great Airmen*, I took great trouble to turn up contemporary records of the earlier pilots whose short biographies are recorded in my book.

In No. 44 of Vol. I of *Flight*, dated October 30th, 1909, reporting the closing stages of the first Blackpool Flying Meeting, it is stated on page 686: "A large crowd of spectators visited the ground, and during the afternoon watched the attempts of British experimenters to fly. The only one to meet with any success was A. V. Roe, who induced his triplane, which now has a 24-h.p. engine fitted, to leave the ground for 40 or 50 yards."

In my recent correspondence with Sir Alliott Verdon-Roe, he assured me that his triplane at the first Blackpool meeting was fitted only with a 9-h.p. two-cylinder J.A.P. engine, and that the four-cylinder J.A.P. was called a 14 h.p. and was fitted to his 9-h.p. triplane when he moved to Wembley Park after the 1909 Blackpool meeting.

It may be of interest to print this letter in *Flight*, in order that it may serve as a guide to those who seek information of the early days of flying and who, like myself, have found some difficulty over different accounts and incomplete records of those times.

Cadgwith, Cornwall. NORMAN MACMILLAN.

I.A.T.A. and Air Fares

I WAS interested in Mr. R. J. Clark's article (*Flight*, July 22nd, 1955) published under the title "Are Air Fares Artificial?" In the first place, I have attended, practically speaking, all I.A.T.A. Traffic Conferences since the end of the war, and I have heard the Association, and its Traffic Conferences, variously described at various times, but not until now have I heard it seriously described as "hidebound." I would have thought that this is one thing that I.A.T.A. is not. It is true that the annual Traffic Conferences vote in a large number of resolutions and recommend practices, but an examination of these shows that they vary to a marked degree from year to year, so keeping pace with developing situations in international civil aviation. It was only in 1953 that entirely new resolutions became effective introducing tourist-class travel, which was associated with substantial fare-reductions. Already more than three-quarters of Europe's international air passengers regularly use the tourist-class air services.

A point about I.A.T.A. which Mr. Clark may not fully appreciate is that every one of its resolutions requires a unanimous vote. As some 59 major air carriers normally take part in the Traffic Conferences, and as unanimous agreement is usually arrived at on all major issues, I.A.T.A. must surely be regarded as a remarkable achievement in international relationships. As yet the U.S.S.R. and some of its associates have not joined the Association; but, apart from these territories, it is a fact that a passenger can today buy an airline ticket from any point in the world to any other point, and be carried on his journey by a great choice of routeings over the lines of many connecting air carriers, and yet pay for his fare in the currency of his country of origin, and require only one air ticket for the entire journey.

If Mr. Clark would consider the progressive and constantly varying character of I.A.T.A.'s resolutions, its unanimous vote requirement, and its international character, then I think he might agree that he was scarcely doing justice to the Association in describing it as a cause of suffering to the travelling public.

After his brief reference to I.A.T.A., Mr. Clark turns at once to the air fares between London and Gibraltar and London and Cyprus, pointing out that they are not under the control of the Association. This is, of course, correct. In fact, no air fares are finally controlled by I.A.T.A., as all the Association's resolutions have to be filed for approval by its members with their respective government authorities. International treaties, dealing with commercial traffic rights for civil aviation, normally require that air fares and air cargo rates shall be agreed upon by the contracting parties; and it has become normal practice for governments to accept the recommendations of I.A.T.A. on fares and rates in fulfilment of this requirement. However, no government is compelled to do so, as all governments are sovereign.

This fact, coupled with the unanimous vote requirement, should surely discount any possibility that the Association indulges in restrictive practices, or forms price rings, to the disadvantage of the general public. One must take some account also of the fact that, were fares not to be regulated by international agreement, then a subsidy race would inevitably follow—and the winner would be the government with the largest pocket.

Air fares to points such as Gibraltar and Cyprus must be examined against this general background. If governments accept the I.A.T.A. machinery for the setting of fares between the U.K. and (say) Lydda, then it is surely questionable to what extent a government should allow the fares so ascertained to be undermined by the use of a colonial point such as Cyprus. If, for its own domestic reasons, a government wishes an especially low fare to come into being between the U.K. and Cyprus, and the sum of that fare with the international fare from Cyprus to Lydda undercuts the established fare from the U.K. to Lydda, then to allow use of the combination fare would undermine the machinery which the interested governments have relied upon to fulfil their treaty obligations. I submit that the U.K. Government maintains a very proper attitude in this respect.

Apart from this most important aspect, there is, of course, the fact to which Mr. Clark has not alluded, namely that "colonial coach" fares are protected at their lower levels by the U.K. Government. Perhaps it is not generally understood that B.E.A. and B.O.A.C. are *not permitted* to undercut, to equalize, or indeed even to reduce the differentials between, their existing fares and the fares applicable to colonial coach services.

There are a good many other points made by Mr. Clark which I would like to have answered on a factual basis, but this letter is already over-long.

Let me end by reverting to my reasons for starting it. Many things may be said about I.A.T.A., but not "hidebound"—not yet, not by a long way.

Ruislip, Middx. P. C. F. LAWTON,
Commercial Director, British European Airways.

Radio Recollections

THE article "In Memory of MF and MF/DF," published in the August 5th issue of *Flight*, will give nostalgic pleasure to those who, like myself, swung the gonios of the 1920s and 1930s and thus experienced the often-trying but always-rewarding job of giving direct personal navigational assistance to aircraft flying in weather foul or fair—mostly foul!

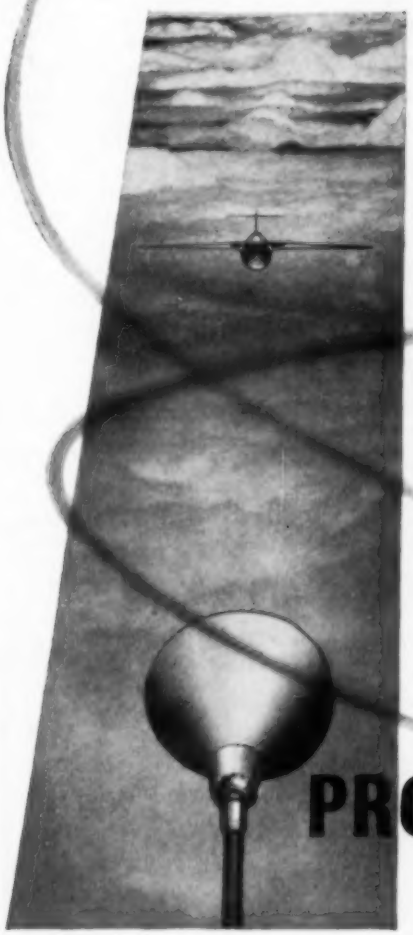
Of course, there is much that could be added to Mr. Oomen's very-easy-to-read description of D/F operation of those happy far-off days, but what we on this side of La Manche would like to voice is the fact of the very high regard we had for our (then) opposite numbers of P.H.A.—whose friendly and very efficient manner of co-operation was, we like to think, reciprocated in like order; just so, too, with all (repeat *all*) those tip-top R/O.s of the K.L.M. Royal Dutch Airlines—none better, none more appreciative.

Sellindge, Kent. LANCE R. RUDD, ex-GEG. GED.

FORTHCOMING EVENTS

Aug. 15-26. Commonwealth Survey Officers' Conference, Cambridge.
Aug. 17-27. Model Engineer Exhibition, New Horticultural Hall, London.
Aug. 19-20. R.Ae.C.: Fourth National Air Races Meeting, including King's Cup Race and Lockheed Aerobatic Trophy Competition, Coventry.
Aug. 21. Northamptonshire Aero Club: At Home.
Aug. 27. Aircraft Golfing Society: Founders' Cup, Stoke Poges.
Aug. 27. R.N.A.S. Aathorn, Cumberland: Air Day.
Aug. 29-Sept. 4. Riviera dei Fiori Aero Club: Rally and "Caravance Riviera des Fleurs."
Sept. 3. Leicestershire Aero Club: Air Display.
Sept. 3-5. U.S. National Aircraft Show, Philadelphia.
Sept. 5-11. S.B.A.C. Show, Farnborough (Public Days, 9th, 10th and 11th).
Sept. 5. S.L.A.E. Main Lecture: "Engineering Aspects of Test Flying," by C. F. Bethwaite, B.Sc., and W/C. P. Brown, R.A.F. (Retd).
Sept. 8. Helicopter Association: Annual Dinner; and Lecture—"Design, Development, Production and Servicing of Rotor Blades," by R. Allen Price.
Sept. 12-18. Battle of Britain Week.
Sept. 19-23. Institute of Metals: Annual Meeting, Buxton.
Sept. 23. Yorkshire Aeroplane Club: Annual Ball, Harrogate.
Sept. 24. Aircraft Golfing Society: Brown Bros. (Aircraft) Trophy.
Sept. 25. St. Albans Model Aero Club: All Britain Model Aircraft Rally, Radlett Aerodrome.
Oct. 7. Helicopter Association: "The Control of Helicopter Rotor Vibration," by P. R. Payne.
Nov. 11. Helicopter Association: "Design of Helicopter Operating Sites," by H. T. Hough, M.I.C.E., M.I.Mun.E., M.T.P.I.
Dec. 16. London Airport inauguration by H.M. the Queen.

Attack



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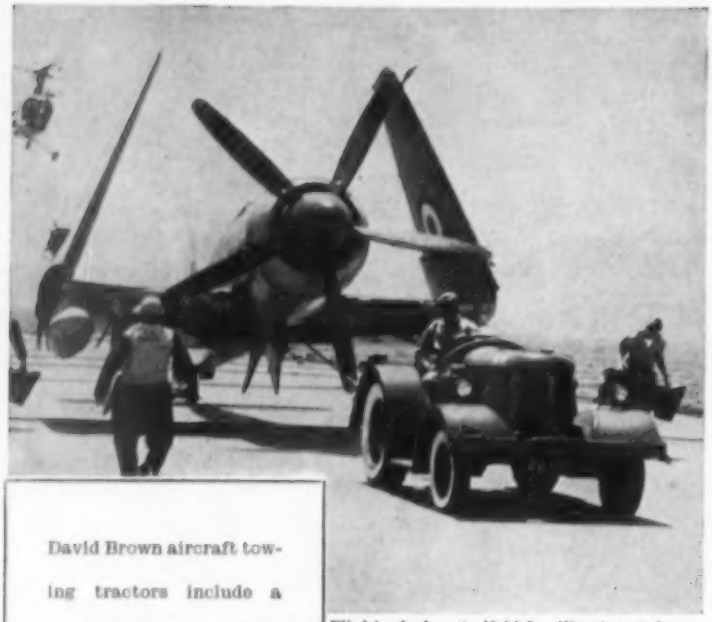

Flight deck of H.M.S. Warrior taken during exercises in the Japanese Inland Sea

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Viscount G-ANRT is the third to be delivered to Hunting-Clan Air Transport. The simple but effective styling of the company's aircraft includes a recently approved heraldic shield.

CIVIL AVIATION

VISCOUNT PROTOTYPE FOR AFRICA

THE much-travelled Viscount 700 prototype G-AMAV left Blackbushe on Monday for a three-month tour of Africa. The main purpose of the visit will be to measure the performance of the aircraft with latest-type Rolls-Royce RDa.6 Dart 510s in high temperatures and at high airfield elevations.

G-AMAV is the first Viscount to be fitted with the Dart 510 and is thus acting as a proving aircraft for the new V.700D series. Most of the 60 Viscounts in production for Capital Airlines and virtually all subsequent aircraft in the V.700 series will be 700Ds. In addition to the more powerful engines, 700Ds have greater internal fuel capacity, provision for slipper tanks and a number of other refinements.

Information gained from the current African trials will, of course, be particularly useful to Central African Airways, the first of whose five V.748s is due for delivery early next year.

The prototype Viscount was due to have arrived at Khartoum on Tuesday—having flown *via* Nice, Malta, El Adem, Wadi Halfa—for a three-week programme of trials. From Khartoum it will proceed *via* Juba, Entebbe, Tabora and Livingstone to Johannesburg for a further six-weeks' test flying. G-AMAV is due to leave Johannesburg on October 20th, arriving home three days later. Vickers say that the test will cover "general performance trials of the Viscount fitted with RDa.6 type 510 engines . . . engine ground running with and without water-methanol engine trimming to given temperatures, oil temperature suitability, engine bay cooling, and a general engineering check on the engines, propellers and airframe."

In addition to its crew the Viscount will carry 20 engineers and observers, including representatives of Vickers, Rolls-Royce, Dunlop, Rotol and de Havilland Propellers, and an A.R.B. pilot. The captain of the aircraft and tour manager is a Vickers-Armstrongs test pilot, Colin Allen.

The present tour is G-AMAV's second series of Viscount trials. Other Viscounts to have visited Africa were the original V.630 prototype and, more recently, the first Hunting-Clan Viscount.

The cockpit of the new Lockheed Electra turboprop airliner, displayed here in mock-up form, will be the first to conform to all the requirements of the S.A.E. Standardized Cockpit Committee. Watched by two members of the committee, Mr. M. G. Beard of American Airlines, who have ordered 35 Electras, is seen assessing the new layout.

PANAM HIRING PILOTS

UNPRECEDENTED travel demands are obliging Pan American to hire 120 pilots. Three hiring teams are now engaged on a nation-wide tour interviewing candidates and employing them on the spot. The greatest shortage is on the Atlantic sector, where the Clippers are making a record 120 crossings a week, but the need is a continuing one. The company is now taking delivery of seven DC-7Bs and has on order 33 DC-7Cs.

AIRSCREWS FOR THE HERALD

IN the design of the de Havilland duralumin airscrew blades for the Handley Page Herald (subject of a full description on pages 260-265 of this issue), provision has been made for the increases of power which may be expected from the Alvis Leonides Major. The capacity of the blades, say the makers, is adequate to absorb much more than the Major's current take-off rating of 870 s.h.p. The airscrews are Hydromatic units of 11ft diameter, with the de Havilland serial number 3/2500/4 (3 denotes the number of blades, 2500 the blade shank size and 4 the engine shaft size).

Operating features of the airscrews include constant-speeding; feathering; automatic pitch-coarsening in the event of power loss on take-off; hydraulic pitch-locking; thermal or fluid de-icing; and—if specified—reversing. The hydraulic pitch-lock, incidentally, is a device originated by de Havilland which immediately secures the blade in the angle at which they are operating should there be a loss of governor control, or if for any other reason the blades tend to "fine-off." Similar airscrews have been selected for the Scottish Aviation Twin Pioneer.

NEW REDIFON ORDERS

AMONG recent developments announced by Redifon, Ltd., is a B.O.A.C. order for a second Britannia flight simulator. The first, on completion of calibration tests at Redifon's Crawley factory, will be installed at London Airport for pre-service crew training. The makers estimate that familiarization of entire Britannia crews will be possible on this simulator at one-tenth of the cost of actual flight training.

Redifon have also announced an order from India's Civil Aviation Department for 46 air navigation beacons and communications transmitters. Thirty similar Redifon installations are already in use at many of the main Indian airports.

AIR SERVICES APPROVED

THE M.T.C.A. announce Ministerial approval, after consideration of the Air Transport Advisory Council's recommendations, of the following air services:

B.K.S. Air Transport, Ltd.—A normal scheduled service between Leeds (Yeadon) and Southend (technical stop) and Paris (Le Bourget).

Hunting-Clan Air Transport, Ltd.—An all-freight service between the United Kingdom, Malta and points in East, Central and West Africa until February 22nd, 1965.

Starways, Ltd.—An amendment has been approved on the internal service between Liverpool and London Airport increasing the frequency to 15 return flights per week.

Interior layout of the Boeing 707 Stratoliner is shown for the first time in these photographs of a cutaway model. Ahead of the crew compartment is a radar scanner; behind it, the main cabin, with entrances fore and aft. This model is arranged as a 108-seat tourist aircraft, with five-abreast seating (right). Windows, of rectangular form, are spaced 20in apart. Boeing have applied to the C.A.A. for a type certificate.

CIVIL AVIATION . . .

MR. MASEFIELD'S CRYSTAL BALL

SPEAKING in Seattle on August 9th, during the I.A.S. turbine-transport symposium, Mr. Peter Masefield predicted that seven categories of transport aircraft—all turbine-powered—would be bought by the airlines in large numbers during the period 1958-66. In looking so far ahead, said Mr. Masefield, "I am sticking my neck out a long way." One fundamental, he believed, would remain true for the next decade: for the same amount of payload, the turboprop would be 20 per cent cheaper to operate than the jet but 100 m.p.h. slower; alternatively, the jet must be built to carry 25 per cent more payload than the turboprop over the same range if it was to achieve the same operating cost. The "seven categories" defined by Mr. Masefield were as follows:—

"**First** the long-range jet. In the next decade, this 'No. 1 Prestige Type'—designed to fly non-stop across the American Continent and non-stop, with high regularity, from London to New York—will have to cruise at around 550 m.p.h. and carry rather more than 100 passengers. It will, I suppose, eventually weigh pretty close to 300,000 lb gross and it will cost getting on for $6m (£2.15m) . . . I guess a world market for something like 200 of these aircraft . . . the only two present contenders here appear to be the Douglas DC-8 and the revised Boeing 707.

"Now the **Second Category** is, I believe, the long-range turboprop transport—capable of doing the same non-stop journeys as the 'Category One Jet,' about 100 m.p.h. slower and about 20 per cent cheaper, carrying the same sort of payload—about 20,000 lb or 100 passengers. This 'Category Two Turboprop' will gross, I suppose, at about 180,000 lb and cost somewhere around $3.5m (£1.25m) each. I guess a world market for about 400 of these long-range turboprops. . . . The Bristol Britannia and a turboprop version of the Lockheed seem to be the two present contenders in this class.

"The **Third Category** is the medium range jet. I believe that there is a somewhat restricted world market for this sort of aeroplane—a 70-passenger, 150,000 lb, 500 m.p.h. aeroplane, capable of flying 2,000 miles non-stop. This aeroplane is coming along and, in my opinion, will sell to the extent of about 100 aircraft. It will cost about $2.5m (£900,000). The de Havilland Comet 4 will be right in this class.

"Then **Category Four** . . . represented by the Lockheed Electra and the 'Viscount successor.' This 'work-horse' of air transport needs to carry between 70 and 90 passengers—according to seating density. It must cruise at rather better than 400 m.p.h. and it will weigh around 100,000 lb. . . . The cost will be not quite $2m (£700,000) each. I believe that there will be a world-market for at least 500 of these aeroplanes.

"Next, **Category Five**—the second string in the 'work-horse' stable for medium and short-haul jobs. Again this will be a turboprop—I'm sure of that. The requirement is, I think, for between 50 and 60 passengers. The cruising speed should be about 350 m.p.h., the gross weight around 65,000 lb. . . . I fancy there is a world demand for some 400 of these aeroplanes at around $1m (£350,000) each. . . . The chief contender here is, obviously, the Viscount-Major—the V.800 series with the boosted Dart engine.

"**Category Six** is one of the most difficult—our old friend, the 'DC-3 Replacement.' The DC-3 never can be replaced by quite the same article. But I believe that most of the attempts to replace it—and they have all failed—have had too big a seating capacity. I foresee a demand for a relatively small and cheap four-motor aeroplane, preferably using turboprops of about 600 or 700 h.p. each. It should cruise at about 280 m.p.h. and carry 30 passengers, or a few less. The gross weight would come out at about 20,000 lb and the cost, I suppose, around $400,000 (£140,000) each. The market for these aircraft is most difficult to guess. But it should not be less than about 600 aircraft. . . . No aeroplane has been designed quite in this category at present.

"Finally, **Category Seven**—a large, multi-engine helicopter, designed to fly directly between city centres up to 250 miles apart, as well as between a few major airports and their city centres. All our studies lead us to believe that the helicopter cannot be made into a true commercial proposition until it has around 50 seats and cruises at not less than 150 m.p.h. The powerplant would be two—or perhaps four—turboprop type engines, with a total of not less than 8,000 s.h.p. The vehicle would be expensive—at 60,000 lb gross weight it would cost not less than $1.5m (£500,000). I am sure, however, that if such a helicopter can be produced in the next ten years, then at least 500, and their developments, would be sold. . . .

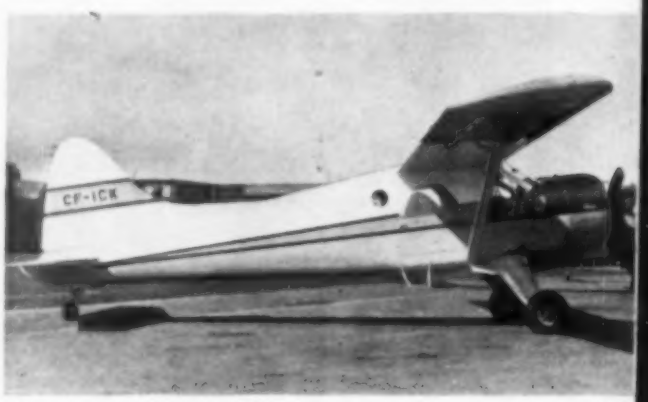
"Those seven categories do, I believe, cover the major requirements of the major scheduled air transport operators. Each of the seven types will, obviously, develop in service. And you will see that they add up to a requirement for about 2,700 aircraft costing more than $7,000m (£2,500m), with spares. Between them, they would require a production of about 1,800 jet engines of two types and about 13,400 turboprop engines of four types. That's the ratio I see in the era I'm thinking of.

"One of the major things which will be controversial is the ratio of jet to turboprop aircraft. . . . I have suggested that there will be a requirement for 300 jet aeroplanes with 1,200 engines, compared with 1,300 turboprop aircraft with 5,200 engines—rather more than four to one in favour of the turboprop. On the money side, I have suggested tentatively that the jet-transport orders will be worth a total of $1,800m (£642m) against $4,000m (£1,430m) for the turboprops."

THE KILIMANJARO ACCIDENT

THE findings of the Court of Inquiry into the East African Airways DC-3 accident were published earlier this month. The accident, which marred E.A.A.'s previously unblemished record, occurred on May 18th this year, when VP-KKH, flying from Dar-es-Salaam to Nairobi, struck the Mawenzi peak of Kilimanjaro with the lost of all 16 passengers and four crew.

The report found that the basic causes of the accident were the captain's decision to fly dangerously near the mountain, coupled with the amount of cloud near Kilimanjaro at the time. The site of the impact was only 7 n.m. from the direct track from Dar-es-Salaam to Nairobi. The Court described the flight plan as a "misnomer," since it was evident that it was prepared before the crew had collected the weather forecast for the route. Had the pilot discussed the weather with the forecaster "he might well have decided to proceed *via* Tanga. . . . It must be remembered, however, that he was fairly new to the Corporation, and he might



Nearly 300 civil Beavers are now operating in 36 different countries. Among the operators of this outstanding de Havilland Canada bush transport are a number of scheduled airlines, one of the latest—represented here—being Queen Charlotte Airlines, British Columbia.

have thought it impolitic to depart from normal practice."

It was possible, said the report, that the pilot saw the dry salt lakes near the Pangani River through broken cloud and mistook them for Lake Jipi [his last reported position]. Except on an airway there was nothing wrong about an aircraft being a few miles one side or another of a planned track, but as this route lay so near to high ground it should never have been flown other than under good visual conditions.

The report made a number of recommendations, one of which urged the formation of a permanent committee to consider ways of increasing the safety of air traffic in East Africa, including the introduction of further advisory routes and the provision and siting of additional and more efficient radio beacons. Pending the completion of a new beacon at Manyani, the report advised adherence to a temporary route via Mombasa and Tanga for flights between Dar-es-Salaam and Nairobi. The Court felt unable to determine the extent to which lack of oxygen had impaired the judgment of the crew (the accident was at 14,500ft above sea-level), but noted that oxygen was not available to the crew. Installation of an additional magnetic compass in E.A.A.'s DC-3s was also suggested in the report.

B.E.A. recently announced the appointment of Mr. G. O. Waters (left) as chairman and managing director of Air Terminals, Ltd. His successor as B.E.A.'s traffic director is (right) Mr. Edwin Whitfield, formerly special assistant to the chief executive.

BREVITIES

THE Ceylonese Director of Civil Aviation is reported to have told the Minister of Transport for Ceylon that unless the airport and runway are immediately brought up to international standards, he will be forced to close Ratmalana Airport, Colombo, and divert aircraft to Katunayake, the R.A.F. airfield.

* * *

The Kawasaki Co. of Japan is reported to have won an Indian Government tender for supplying five helicopters. The aircraft will be licence-built Bell 47Gs costing some £14,000 each.

* * *

Mr. H. O. Houchen, general manager stations and traffic, has been appointed a deputy operations director of B.O.A.C. Mr. J. R. Stainton, the Corporation's general sales manager, will succeed Mr. Houchen as general manager stations and traffic; Mr. G. Lee will succeed Mr. Stainton as general sales manager.

* * *

Until June 30th next year Manston will not be available for use by civil aircraft, and Customs facilities for clearance of passengers and crews of scheduled service aircraft have been withdrawn. The R.A.F. station at Wattisham, Suffolk, will be available in place of Manston as a master diversion airfield.

During their two-year period of service with B.E.A., the two Viscount 736s built for Fred Olsen Airtransport will have British registrations G-AODG and G-AODH. The third of Fred Olsen's Viscounts will be a V.700D with the type-number 766.

* * *

On August 9th Lufthansa completed their 100th Super Constellation crossing of the North Atlantic since regular services began on June 8th.

* * *

Airwork announce the appointment of Mr. H. G. Matheson as their manager in Germany. Mr. Matheson, who began his civil aviation career with Imperial Airways in 1932, was until recently commercial manager to Hunting-Clan Air Transport, Ltd. Airwork have also announced the retirement of Lt. Col. B. A. Wilson, who joined the company in 1942 and has been one of their sales staff.

* * *

Fairways (Jersey), Ltd., are registered owners of the Avro XIX, G-AHIG, which ditched near Calshot Pier on August 6th after engine trouble during a flight from Jersey to Blackbushe. Evidently a high-density version of the familiar Anson, the aircraft was reported to have been carrying a pilot and ten passengers, all of whom survived.

FROM THE CLUBS

THIRTY pilots and student pilots—all of them employees of the Smiths Group of aviation companies—took part in last month's rally at Thruxton, flying there from such widely scattered points as Denham, Luton, Southend, Stapleford and Staverton in nine aircraft. Prize-winners were Mr. R. Bagot, flying a Herts and Essex Club Auster (spot landing); Mr. T. Kennedy in a Cotswold F.C. Tiger Moth (time of arrival); and Mr. C. F. Matthews, whose radio-equipped Auster from Southend Flying Club won the concours d'elegance. Both Smiths and Kelvin Hughes run assisted flying schemes. Smiths employees taking advantage of the scheme number 46—15 of them licence-holders—and hours flown by them over the past three years total 1,000. Forty-eight employees of Kelvin Hughes have applied to take part since this company's assisted flying scheme was launched last summer.

A NEW chief flying instructor, Mr. Eric Hustwayte, is now installed with the Coventry Aeroplane Club, which also reports that flying hours from the beginning of the year to the end of July exceed 500 hours. This total was not reached until November last year.

FORTHCOMING events noted in the newsletter of the Yorkshire Aeroplane Club include the annual ball, to be held at the Hotel Majestic, Harrogate, on Friday, September 23rd (tickets 30s, from the secretary), and the competition for the R. H. Braime Navigation Trophy, which is open to both student and private pilots. The closing date for the competition is September 20th, and details may be had from the C.F.I. The newsletter also congratulates club-member Mr. Peter Green "on completing his first solo amid, to the C.F.I.'s horror, a sudden and unexpected storm."

HOURS flown by the Wiltshire School of Flying at Thruxton during the first half of 1955 amounted to 1,358—185 more than in the first half of 1954. The school has announced a number of staff changes. In particular, Mr. John Heaton has taken over from Mr. Wade-Palmer as C.F.I. He will be assisted by Mr. Cook, until recently an instructor with Airwork, and Mr. Mumtaz, who, at the beginning of this year, was an *ab initio* pupil with the school, and has qualified in turn for his P.P.L. and his instructor's rating "and is now in the last throes of his commercial licence."

THE Home Counties Flying Group, which recently operated from Denham, has now transferred to its new base at Panshanger aerodrome. P.P.L.-holders interested in flying the group's Tipsy Trainer (£2 2s per hour) should write to the secretary, Mr. R. P. Mayes, 47 The Birches, Winchmore Hill, London, N.21, for further details.

YET again the weather conspired to limit the activities of the Vintage Aeroplane Club on July 24th, when low cloud persisted until lunch time, preventing 14 out of the 30 Rally entrants from reaching the field, as well as half of the display items. However, an impromptu programme was hurriedly arranged for the benefit of the large crowd which assembled as the sun came out after lunch, and the garden party atmosphere was developed with the aid of the sideshows.

In the air, Ranald Porteous delighted the onlookers with one of his superbly judged displays, and Terry Dawson proved that he was as much at home when upside down in a Magister as when the right way up. The hardy Vintage Club Formation team split up after their fly past and performed individually, "Pander" Watson cavorting in the Tiger Moth, Dennis Sweeting in the Spartan, and—in the Club's own Cadet—Ron Gillman, who confesses that he inadvertently discovered a new aerobatic manœuvre to be known as the "fall off the top." Bill Sykes leaped from an Auster with commendable precision attached securely to a parachute, and—according to a Denham correspondent—"Wilbur" Wright, Denham's C.F.I., "went mad in a Piper Cub and had to be shot." A balloon bursting competition was won by Harold Blank of the Airways Aero Club.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

A foretaste of things to come in the not-too-distant future: An Avro technician demonstrates the method of entry to the Vulcan.

The Aird Whyte Trophy

THIS year's winner of the Aird Whyte Trophy for Coastal Command weapons efficiency was No. 201 Sqn., from Pembroke Dock. The competition was held on the bombing range at Fowey, Cornwall, where a waterborne moving target had to be attacked with front guns and bombs. Runners-up were respectively No. 224 Sqn., Gibraltar, and No. 206 Sqn., St. Eval.

R.A.F. Benevolent Fund

THE thirty-fifth annual report of the Fund, for 1954, has been published. It states that expenditure will continue at a very high rate for many years, and that no opportunity must be lost of securing the maximum income year by year. In the years to come, many of the men who fought in the 1939-1945 war will be in need of assistance to see them through their old age.

Hunters in the Middle East

EIGHT Hunters from C.F.E. West Raynham left last Friday for a 5,500-mile tour of the Middle East. They will return to England on August 31st. The aircraft will fly through Germany, Italy, Greece and Turkey, on the way to Cyprus. Apart from Germany, where some R.A.F. squadrons are now receiving Hunters, it will be the first time that Hunters have been seen in these countries.

The object of the visit is to discuss with headquarters staffs, and also at wing and squadron level, in the Middle East Air Force current and future fighter operations and tactics. The Hunters will also take part in an air defence exercise in Malta. The C.F.E. party will be led by the Commandant, A. Cdre. J. Grandy, D.S.O.

A Canberra will fly ahead of the Hunters to reconnoitre the weather and two Valettas and a Hastings will carry ground servicing parties.

The Hunters left West Raynham at 6 a.m. last Friday, arriving at Capodichino (Naples) in the afternoon, having made stops at Wahn and Fürstenfeldbruck in Germany, and at Istrana, near Venice. Next day they were flying to Ellenikon (Athens) with a stop at Brindisi, and on Monday they were going on to Nicosia (Cyprus) *via* Eskeschir (Turkey). The next ten days were to be spent on visits to M.E.A.F. units. On August 25th the Hunters will return to Ellenikon (again flying *via* Eskeschir) and on August 26th fly to Malta *via* Brindisi to take part in air exercises from August 27th to 29th. On August 30th they will go to Istrana *via* Capodichino and on August 31st return to West Raynham *via* Fürstenfeldbruck and Wahn.

R.A.F. Sports

THE men's singles of the R.A.F. lawn tennis championships were won by L.A/C. W. A. Knight, who beat A/C. M. G. Davies 6-2, 6-2 in the finals. Both were members of this year's British Davis Cup team. In the men's doubles Knight and Davies beat F/L. N. R. Lewis and A/C. A. Scarlett.

In the women's championships Sq/O. J. Mattock beat Flt/O. N. Fernihough 6-2, 7-5, and in the doubles Sq/O. A. Penfold and Flt/O. Fernihough beat Sq/O. Mattock and F/O. W. J. Webb, 6-2, 3-6, 6-0.

At Lords the R.A.F. beat the Royal Navy by ten wickets.

Canberras and Hunters at Metz

THE French National Air Meeting at Metz at the end of last month saw a spectacular series of performances by no fewer than five formation teams. They were the No. 11 Group Hunter team of No. 54 Sqn. from Odiham, the Canberra T.4 team from No. 231 O.C.U., Bassingbourne, the T-33s of the American Acrojets and the Ouragans of the Patrouille de France, based at Cambrai.

No. 54 Sqn. put up the finest Hunter display seen this summer, while the Canberras, despite their slower speed, performed some very tight and well-placed manœuvres. The formation was led by the C.O., W/C. A. J. Picknett, and the other three aircraft were flown by S/L. J. F. C. Melrose, S/L. S. G. Hewitt and F/L. R. I. Young. The individualist, S/L Hewitt, at one point rejoined the rest of the group by rolling off the top of a loop after making a pass in the opposite direction.

A new line in fly-pasts was provided by 12 Ouragans of No. 4 Sqn., French Air Force, which carried out a six-minute tail chase over the crowd of between 100,000 and 200,000 people.

A Near Thing

OFF Brass Point on the South Coast recently, the crew of a Whirlwind of No. 22 Sqn., Coastal Command, beat the Newhaven and Eastbourne lifeboats by a short head to reach and rescue two civilians reported stranded on a rock close in under the cliffs. It appears that the civilians did not at the time want to be rescued; but they are said to have enjoyed the unexpected flight.

R.A.A.F. in Malaya

ADVANCE parties of No. 2 Airfield Construction Unit are to lengthen the runway at Butterworth in readiness for the arrival of the fighter wing of two squadrons which will be part of the R.A.A.F. commitment for the strategic reserves in Malaya. No. 1 Bomber Sqn. has already been there for some years.

Her Majesty the Queen has approved the award of the D.F.C., for active service with No. 1 Sqn. in Malaya, to S/L. H. F. Moore, and of the B.E.M. to F/Sgt. J. B. Jarrett. S/L. S. W. Trewin and Cpl. K. J. Herring have been Mentioned in Despatches.

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A NEW aid to helicopter rescue has been devised by Lt-Cdr. J. S. Sproule, who was responsible for the scoop net. It is a stretcher with collapsible canvas side-walls and can be raised to hang alongside the cockpit by the normal winch. The patient is protected, but can be attended in flight. The stretcher could also be used for transfer of patients from ship to ship by jack-stay.

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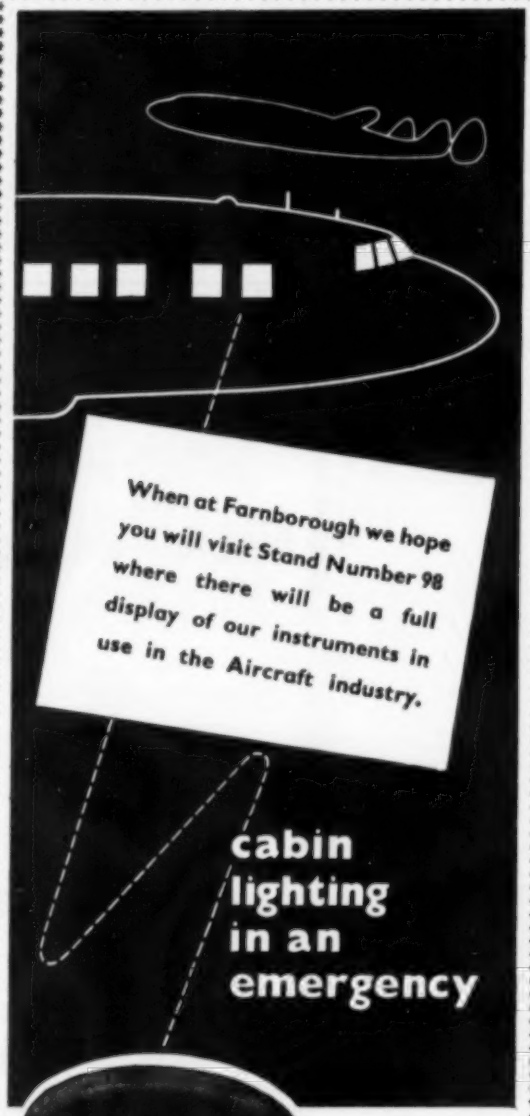
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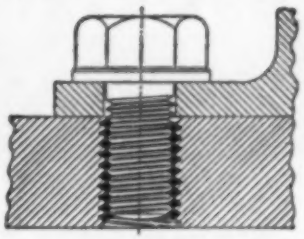

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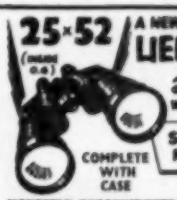

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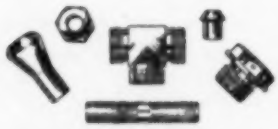

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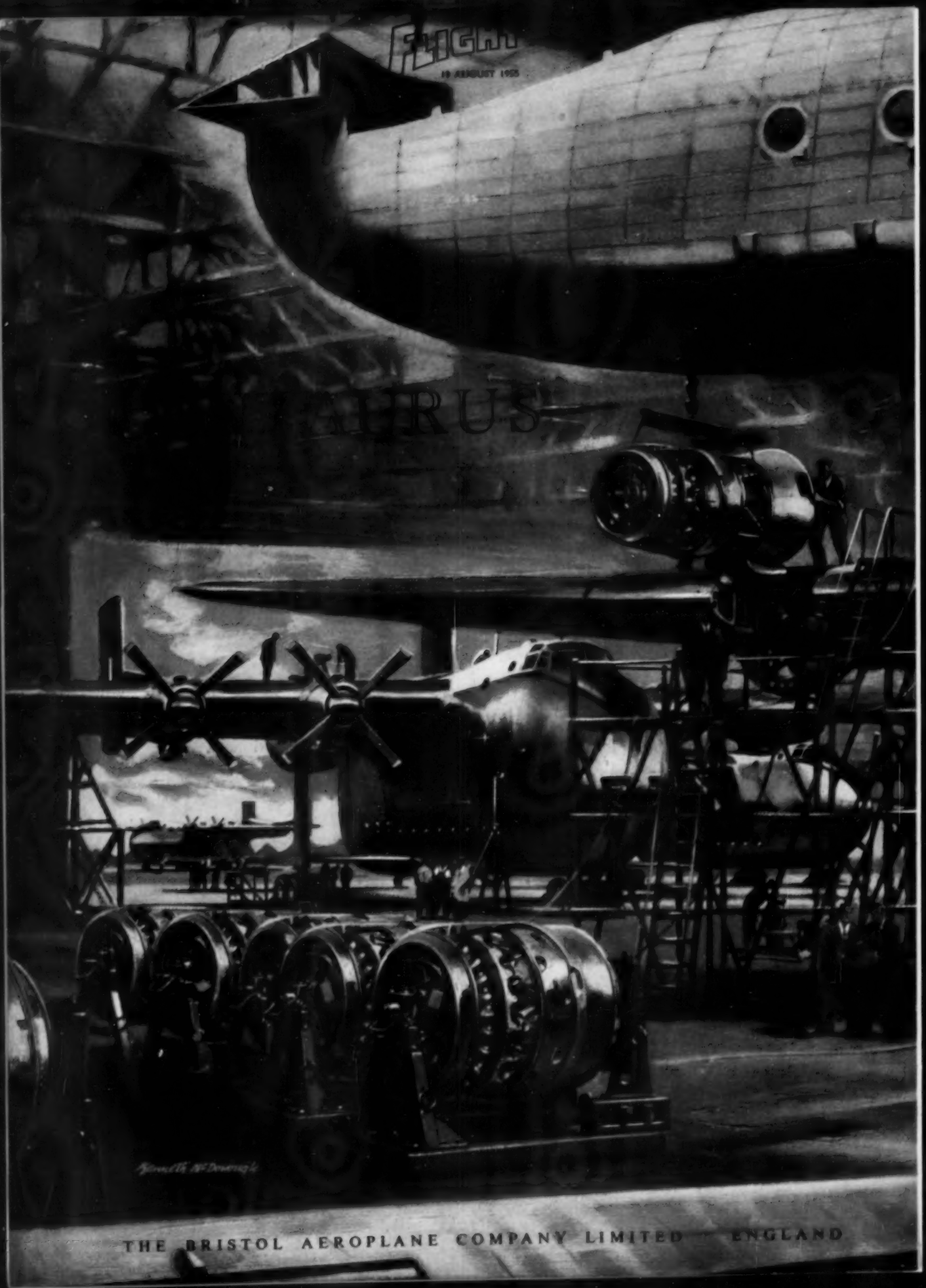

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